THE JOURNAL OF ENGINEERING EDUCATION

Published by the Society for the Promotion of Engineering Education

Published under the Supervision of the Publication Committee.
H. P. Hammond, D. S. Anderson, F. L. Bishop, Editor, University of Pittsburgh.
Published at Prince and Lemon Sts., Lancaster, Pa.

Entered as second-class matter at the Post Office at Lancaster, Pa., under the Act of March 3, 1870.

New Series
Vol. XXVIII, No. 3 NOVEMBER, 1937 Subscription Price, $3.00 per year. Single Copies, 50 cents

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COMMITTEES AND COMMITTEE WORK

By S. B. Earle, President of the Society

It has been often said the best way to kill anything is to refer it to a committee. This certainly cannot be said of the Society for the Promotion of Engineering Education. The Council has authorized quite a number of committees covering the various interests of the Society and the members of these committees have been quite active in the past and have made some very valuable reports which have been printed in the Journal of Engineering Education. These reports are not only edifying to all the members of the Society but also have helped to advance the thought covering the various fields and have stimulated the teachers in that field to better efforts. While realizing that it may be somewhat of a burden to some of the members to be retained on these committees, and particularly for the chairman of the committee, I recognize that Past President Hammond, knowing the personnel of the Society as probably few others, gave careful consideration to the appointment of committees. Believing that many of these committees have become interested in the work of the committees and feeling that better results will be obtained by their continuing on the committee, I have only made certain adjustments and changes in the committees which I hope will be for the best interests of the Society. Some of the committees are already having meetings and I hope that the others will begin their work at once so that they will have time to make thorough studies before their report next June.

The growth of the Society last year was most gratifying. While there was some suggestion as to changes in the Membership Committee, I have followed the same general plan of having a representative of the various schools to act on the committee and am delighted to find that some of these have already done some excellent work and many additions have been made to the Society's membership from a number of institutions.

I hope the committees will be as diligent in their work this year as they have been in the past when such excellent reports have been made.

MEMBERSHIP COMMITTEE, 1937–38

President Earle appointed a Membership Committee for 1937–38—one member in each institution, himself as Chairman. We are giving herewith a report of the activities of this Committee as of October 30.

Alabama Poly. Inst.	1	New York, Coll. City of	1
Alfred Univ.	4	New York Univ.	2
Bucknell Univ.	1	North Carolina State Coll.	28
California, Univ. of So.	2	North Dakota, Univ. of	1
Carnegie Inst. of Tech.	1	Northwestern Univ.	1
Colorado, Univ. of	2	Ohio Univ.	1
Columbia Univ.	1	Ohio State Univ.	2
Connecticut State Coll.	1	Oklahoma, Univ. of	1
Dartmouth College	2	Pennsylvania State Coll.	1
Drexel Inst.	5	Pittsburgh, Univ. of	1
Florida, Univ. of	2	Rhode Island State Coll.	2
Georgia School of Tech.	3	Rutgers Univ.	2
Illinois, Univ. of	1	Southern Methodist Univ.	3
Iowa State College	2	Tennessee, Univ. of	7
Iowa, Univ. of	1	Toronto, Univ. of	1
Kansas State College	1	Tulane Univ.	1
Louisiana State Coll.	1	Vermont, Univ. of	1
Maine, Univ. of	3	Virginia Poly. Inst.	2
Mass. Inst. Tech.	4	Washington, Univ. of	3
Michigan State Coll.	7	West Virginia Univ.	3
Michigan Coll. M. & T.	6	Others	9
Mississippi, Univ. of	1		
Missouri, Univ. of	5	Total 10/30/37	134

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Progress: C. F. Scott, Chairman, Yale University, New Haven, Conn.; H. C. Carpenter, F. C. Bolton, S. B. Earle and P. W. Ott.

Lamme Award: E. B. Roberts, Chairman, Westinghouse E. & M. Co., Pittsburgh, Pa.; for four years, D. C. Jackson, 5 Mercer Circle, Boston, Mass., R. C. Ernst, University of Louisville, H. B. Langille, University of California; for three years, G. W. Case, University of New Hampshire, W. E. Freeman, University of Kentucky, H. S. Evans, University of Colorado; for two years, E. B. Roberts, Geo. B. Thomas, 463 West St., New York City, Frederick Bass, University of Minnesota; for one year, D. B. Prentice, Rose Polytechnic Institute, R. W. Sorenson, California Institute of Technology, S. C. Hollister, Cornell University.

Membership: S. B. Earle, Chairman, C. R. Hixon, J. R. Cudworth, W. R. Spencer, B. M. Woods, A. C. Terrill, W. H. Austin, D. B. Pheley, A. G. Gehrig, H. H. Bliss, F. Paulsen, F. Bailey, F. W. Rose, F. H. Sexton, A. Mailhoit, W. E. Lovell, J. W. Turnbull, S. W. Dudley, T. D. Mylrea, L. K. Downing, N. C. Ebaugh, R. C. Brinker, J. B. Finnegan, W. C. Bauer, A. A. Potter, D. B. Prentice, E. L. Waterman, L. E. Conrad, R. C. Ernst, J. M. Robert, S. S. Steinberg, C. E. Tucker, M. S. Munro, H. H. Higbie, A. R. Carr, G. W. Swenson, L. L. Patterson, Harry Rubey, A. S. Langsdorf, O. J. Ferguson, G. W. Case, F. D. Carvin, C. H. Willis, E. H. Wells, E. J. Streubel, S. C. Hollister, Bro. A. Leo, A. B. Newman, Louis Mitchell, J. C. Park, W. E. Duckering, G. C. Sagen, W. W. Hartshorn, C. E. Cherry, L. T. Black, F. O. Rose, F. W. Hinrichs, F. B. Lindsay, G. L. Sullivan, A. B. Domonske, E. R. Kiely, W. L. Malcolm, R. D. French, A. R. Zimmer, H. S. Evans, G. W. Salver, E. R. Moore, J. R. Lapham, E. A. Valade, R. L. Sweigert, H. F. Gauss, D. C. Jackson, Jr., F. B. Seely, R. E. Rich, Frank Kerekes, I. C. Crawford, W. E. Freeman, L. J. Lassalle, Paul Cloke, C. S. Ell, G. M. Fair, Ralph Earle, C. J. Freund, H. B. Dirks, S. C. Lind, A. D. Taylor, J. B. Butler, W. M. Cobleigh, F. H. Sibley, G. W. Barnwell, H. N. Lendall, M. E. Farris, J. H. Butler, S. S. Edmands, J. C. Rathbun, Theo. Baumeister, S. K. Barrett, M. M. Boring, J. J. Devine, B. R. Van Leer, F. E. Ayer, R. S. Burington, LeRoy Tucker, D. M. Palmer, R. H. Dearborn, P. S. Donnell, G. A. Irland, Dawson Dowell, W. N. Jones, R. L. Wales, L. S. LeTellier, R. L. Sumwalt, A. Karsten, W. R. Woolrich, E. H. Flath, H. F. Godeke, W. J. Cope, J. B. Jones, A. R. Drucker, G. P. Boomsliter, F. A. Kartak, W. J. Seeley, E. F. Chandler, H. Schneider, B. H. Bush, B. T. Schad, J. H. Felgar, B. Stoughton, P. P. Rice, G. E. Crofoot, H. C. Pavian, H. P. Hammond, W. H. Kenerson, D. D. Curtis, H. M. Crothers, F. L. Wilkinson, N. F. Rode, L. A. Pipes, G. D. Clyde, G. F. Eckhard, W. S. Rodman, E. A. Loew, B. G. Elliott and R. D. Goodrich.

DIVISIONS OF THE SOCIETY

Chemical Engineering

O. A. Hougen, *Chairman*, University of Wisconsin, Madison, Wis.
R. C. Kintner, *Vice-Chairman*, Armour Inst. Tech., Chicago, Ill.
J. C. Whitwell, *Secretary and Treasurer*, Princeton Univ., Princeton, N. J.

Civil Engineering

H. C. Bird, *Chairman*, Duke Univ., Durham, N. C.
P. P. Rice, *Secretary*, Lafayette College, Easton, Pa.
H. T. Heald, Armour Inst. Tech., Chicago, Ill.
P. P. Rice, Lafayette College, Easton, Pa.
} Directors 3 years.

Coöperative Engineering Education

E. H. Flath, *Chairman*, Southern Methodist Univ., Dallas, Texas.
R. D. Landon, *Secretary*, Southern Meth. Univ.

Electrical Engineering

Harold W. Bibber, *Chairman*, Ohio State University., Columbus, Ohio.
C. E. Tucker, *Vice-Chairman*, Mass. Inst. Tech., Cambridge, Mass.
G. W. Swenson, *Secretary*, Mich. College M. & T., Houghton, Mich.
J. W. Barker, Columbia Univ., New York City.

Engineering Drawing

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Mechanical Engineering

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Allison Butts, *Secretary*, Lehigh Univ., Bethlehem, Pa.

REPORT OF CONFERENCES *

CHEMICAL ENGINEERING

This was the first conference held under the auspices of the Chemical Engineering Division which was officially organized at the Madison Wis., meeting in June, 1936. Previous conferences have been arranged and sponsored by a chemical engineering committee. A total attendance of 60 representing 40 universities, colleges, and industrial organizations surpassed all previous records and indicates the rapidly mounting interest in this activity of the Society.

Two sessions and a business meeting were held on Tuesday, Wednesday, and Thursday, June 29, 30, and July 1. On Thursday afternoon the Division participated in a joint conference with Engineering Economy at which W. M. Cobleigh (Montana State College), representing the Division, read a paper on "Engineering Economy in Relation to Chemical Engineering Instruction." The Division dinner was held on Tuesday evening to which the ladies were invited and was attended by more than 50 persons. The Divisional Executive Committee met at luncheon on Wednesday, and on Thursday a Division luncheon preceded the business meeting.

Mimeographed copies of the papers presented with one or two exceptions were supplied to those attending and copies of these are in most cases still available from the individual authors.

On Tuesday afternoon the opening session met at the Massachusetts Institute of Technology and was greeted by Professor C. S. Robinson of M. I. T. After opening remarks by Chairman F. C. Vilbrandt (V. P. I.), who presided, the first paper on Graduate Instruction in Chemical Engineering was presented by W. H. McAdams (M. I. T.). Professor McAdams described and explained the course of the graduate instruction, the methods of teaching, and the organization of the graduate work in chemical engineering at the Massachusetts Institute of Technology. Various aspects of graduate instruction in this field were then discussed by Professors W. K. Lewis (M. I. T.), A. H. White (Michigan), and J. C. Elgin (Princeton). In particular Professor Lewis emphasized the value of the quantitative problem method of instruction employed at M. I. T. and that the primary object of the graduate course of instruc-

* Held in connection with the 45th Annual Meeting, S. P. E. E., Cambridge, Mass., June 28–July 1, 1937.

tion should be the development of power in the student. Further details of the administration of graduate work at M. I. T. were explained by McAdams and Lewis in reply to queries from E. M. Schoenborn (Delaware), J. D. Lindsay (Idaho), and Vilbrandt.

W. G. Whitman, Chairman of the Chemical Engineering Department of M. I. T., presented the next paper on The School of Chemical Engineering Practice. He discussed the objectives, organization, administration, facilities, operation, and philosophy underlying the school of engineering practice. Further details were added by Professor Gunness, Director of the Merrimac Chemical Company Station of the Practice School. Following brief discussion by R. N. Shreve (Purdue), Schoenborn, Lindsay, and C. P. Baker (Northeastern) the Coöperative Chemical Engineering Course at the Drexel Institute of Technology was described in a paper by C. A. Kapp, Director of Coöperative Education at Drexel.

At the conclusion of the paper program, through the courtesy of the M. I. T. Department of Chemical Engineering, the assembled members of the Division were conducted to the plant of the Merrimac Chemical Company, Everett, Mass., under the guidance of Dr. Whitman to see the Practice School in operation. Opportunity to insepct parts of the Merrimac plant was also afforded.

The session on Wednesday afternoon met in the Mallinckrodt Chemical Laboratory of Harvard University, Chairman Vilbrandt presiding. H. L. Coles (Univ. of Colorado) opened the session with his paper on Recent Developments in the Teaching of Chemical Engineering Operations. His paper was based on the results of questionnaires sent to chemical engineering teachers and men in industry to investigate changes in methods and materials in teaching chemical engineering and new subjects introduced into the course of instruction in chemical engineering by recent developments in the profession. Among the important changes pointed out were the gradual replacement of descriptive courses in industrial chemistry by quantitative courses in the unit operations, increasing emphasis on the use of problems, greater emphasis on adequate chemical engineering laboratory instruction, and the demand on the part of industry for sound training in the fundamentals and development of the non-technical side of the chemical engineering student. In prepared discussions of Coles' paper, Baker (Northeastern) and M. C. Molstad (Yale) further elaborated and gave their opinions on various of the points raised.

In the next paper on The Order of Presentation of Chemical Engineering Subjects, R. C. Kintner (Bucknell) presented the results of an investigation of the sequence of courses in chemistry and chemical engineering in more than 66 schools teaching chemical engineering. Valuable information on this phase of the construc-

tion of chemical engineering curricula was supplied by the paper. It indicated that the majority of schools now place organic and physical chemistry in the second and third years to precede or accompany chemical engineering subjects and that courses in the unit operations accompany or precede those in industrial chemistry in the majority of cases. In discussing Kintner's paper, H. L. Masson (N. Y. U.) agreed with the sequence of courses indicated by the majority but emphasized the necessity for examining the content of courses designated by general titles. He pointed out the desirability of each institution ascertaining the subject matter of all courses given to chemical engineers for in this way duplication of subject matter between courses, frequently found, might be avoided and a better sequence arranged. He favored the introduction of a descriptive course in the unit operations in the sophomore year followed by a quantitative treatment in the junior year. R. A. Fisher (V. P. I.) felt that course sequence was primarily a question of individual thinking and action on the part of the institution but that professional courses should have the primary position; also, that any course which resulted in the improvement of the student was acceptable and that it was up to the individual teacher to see that this was so. Further aspects of course sequence and content were discussed by Shreve, J. C. Olsen (Brooklyn Polytechnic), W. W. Hodge (West Virginia), T. S. Crawford (Rhode Island State), and Lindsay (Idaho). Concluding the discussion of his paper Professor Kintner stated that his report indicated a varied situation but not an unsatisfactory one and did not necessarily call for changes.

The remainder of the session was devoted to three papers on the chemical engineering unit processes under the chairmanship of Professor R. N. Shreve; Unit Processes in Organic Technology by R. N. Shreve; Thermal Decomposition by W. L. Faith (Kansas State); and A Satisfactory Laboratory Method of Teaching Unit Processes by H. McCormack (Armour Tech). These papers presented descriptions of the content of and methods of presenting lecture and laboratory courses in chemical engineering unit processes. In introducing the papers Professor Shreve stated that in his opinion courses in the unit processes should occupy a larger place in the curriculum. In discussing these papers Professor Olsen expressed the opinion that the papers were good and that such courses have educational value but that in view of the limited time available in the four year course, especially in the laboratory, it was preferable to place emphasis on selected unit operations. He felt that a thorough knowledge of organic chemistry was a prerequisite for such courses and that they were better adapted to the graduate years.

The session concluded with a general discussion of various of the subjects raised by the papers presented in which F. C. Howard (Worcester Polytechnic), Coles, Masson, and J. R. Withrow (Ohio State) participated.

The business session followed the Division luncheon on Thursday. Annual reports of the Chairman and of the Secretary-Treasurer were read. Reports were read by the following Committees: Chemical Engineering Laboratory, McCormack, Chairman; Chemical Engineering Unit Processes, Shreve, Chairman; Curricula Sub-Committee on Order of Subject Presentation, Kintner, Chairman. These Committees were instructed to continue their work during the next year.

Motions were passed creating a Committee on Publications, with the Vice-Chairman of the Division as Chairman and a Committee on Registration of Chemical Engineers, W. W. Hodge, Chairman.

At the request of the Chairman suggestions for subjects to be considered at the next annual conference were submitted to the Secretary by those present.

New officers of the Division for 1937–38 were elected as follows.

Chairman—O. A. Hougen, University of Wisconsin.

Vice-Chairman—R. C. Kintner, Bucknell University.

Secretary-Treasurer—J. C. Whitwell, Princeton University.

A resolution expressing the thanks of the Division to the retiring officers of the Division for their services was unanimously carried.

A resolution extending a vote of appreciation and thanks to the officers and engineering faculties of the Massachusetts Institute of Technology and of Harvard University for the hospitality, entertainment, and assistance rendered to the Chemical Engineering Division during the 1937 Conference was unanimously carried.

J. C. ELGIN, *Secretary.*

CIVIL ENGINEERING

Preceding the annual meeting, which was held at Cambridge, June 30 to July 2, 1937, two days were devoted to Summer Conferences. Of these conferences the one arranged by the Civil Engineering Division was the most elaborate. General meetings of all civil engineers were followed by group meetings divided according to specialized interests. Each of the eight permanent committees of the Civil Engineering Division had prepared a part of the conference program. Hence there was a definite interest for specialists in the following fields: surveying and geodesy, foundations and soil mechanics, construction education, applied hydraulics,

transportation, sanitary engineering, structural engineering, and in educational policy and teaching methods.

As might have been anticipated, the specialty drawing the greatest attention was soil mechanics. The excellence of the papers presented in the field of soil mechanics, combined with the natural interest developed by the opportunity to visit the unique soils laboratories at Harvard and M. I. T., undoubtedly accounted for this exceptional interest. Perhaps the most animated meeting was that of the sanitary group where papers by Professor Gordon Fair and Professor Harold Vagtborg stimulated much discussion. The surveying group found much of interest to discuss despite its intention to adjourn for only a few days before meeting for a two-week conference at Camp Marston in Minnesota.

A paper devoid of all thought of pedagogy was received with exceptional interest and appreciation. This was Mr. G. D. Besler's paper on the Besler Steam Two-Car Train. Much favorable comment was heard about the papers of Professors Hardy Cross, Jasper O. Draffin, and Townley Heald, where the interest centered in academic matters.

The graduate program in civil engineering was discussed at length in papers by Professors S. C. Hollister, Clyde T. Morris, F. T. Mavis, and T. R. Agg. This group of papers covered the fields of highway engineering, hydraulic engineering, and structural engineering. The paper by Professor Hollister was devoted to the general objectives of graduate study in civil engineering.

The annual dinner of the Civil Engineering Division was well attended despite the conflicting interests of a metropolitan center. President C. C. Williams of Lehigh University spoke brilliantly and amusingly about some of the contacts of the civil engineer with government. The new Chairman elected at the dinner meeting was Professor H. C. Bird of Duke University, and the new Secretary chosen was Mr. Paul P. Rice of Lafayette College. Dean H. T. Heald, of the Armour Institute of Technology, and Mr. Paul P. Rice were elected as Directors for a three year period. The retiring officers were L. E. Grinter, Chairman, and K. C. Reynolds, Secretary. The Conference adjourned after the retiring chairman had introduced the new officers and urged the membership to attend the 1938 meeting of the Society at College Station, Texas. Many members inquired about the possibility of combining this meeting with an automobile drive to Mexico City. They were assured of the beauty of the trip and of the excellence of the roads.

L. E. GRINTER, *Chairman.*

CO-OPERATIVE ENGINEERING

Discussion at the 1937 conferences centered around three timely issues of co-operative education outlined by the Chairman, Dean Freund of the University of Detroit.

(1) The significance of co-operative employment in the placement of graduates.
(2) The bearing of unionism of the C.I.O. variety upon co-operative colleges.
(3) The co-ordination of the personnel procedures of co-operative colleges with those of co-operating companies.

Claude L. Peake of the E. I. du Pont de Nemours Company opened up the first topic by outlining his own experiences over several years with students from representative co-operative colleges. Salient points in his address were the following:

While a young man on a co-operative course is in industry he is learning what a machine looks like and how it acts. It is not just a diagram or a picture such as he would get from a book. He is learning what conditions are inside the plant.

One of the first things that a young college man has to learn is that his major objective is to succeed in the job he is on. Ordinarily the co-operative student considers his first co-operative assignment just as a job. He is led to believe that while this furnishes him experience the job is the thing. Attention will be more strongly centered on making good on this particular job and he is probably not so concerned about getting ahead as is the boy who has already graduated. This desire to get ahead is often so marked as to imperil the chances of the young graduate. This is less evident while a co-operative student is in school. "Co-operative" schools teach the man to see the non-college man's viewpoint.

Continuing the discussion of this topic, George W. Burns, University of Cincinnati, and J. E. McDaniel, Georgia Institute of Technology, pointed out other advantages of co-operative training in the placement of graduates, emphasizing its important disciplinary values in a democratic country. Professor Robinson of Fenn College suggested the advisability of encouraging some co-operative students to get their own jobs.

Dean Kartak of Marquette outlined certain intangible advantages of the co-operative plan among which were the development of sound judgment through co-operative experience. He described an experiment he had tried with the senior class at Marquette in which he had obtained the spontaneous reactions of students on a number of current issues in the field of labor problems. The students showed a remarkable grasp of the issues raised.

The second paper presented was particularly timely and of great current interest. Ralph R. Johnson, University of Detroit,

discussed sit-down strikes and co-operative employment on the basis of his experiences in the course of recent C.I.O. strikes in Detroit. During these strikes only six co-operative students at the University of Detroit lost their jobs because of labor trouble. Professor Johnson stated that the following factors, in his opinion, minimized the effect of strikes on co-operative placements:

(1) The policy of the University of Detroit of increasing the number of its co-operating companies and placing fewer students in each plant.
(2) Selling the co-operative program on a straight business basis.
(3) Strict adherence to all agreements and regulations.
(4) Good wages (the average wage being 60c an hour and the range from 40c to $1.10 per hour).

Students were advised to avoid joining unions wherever possible. The co-ordinator kept in constant touch with company representatives in order to be entirely familiar with the viewpoint of the administration in regard to unionizing. In general, the unions were friendly and did not force the co-operative students to join.

At its second meeting, the division considered the problem of co-ordinating the personnel procedures of co-operative colleges with those of co-operating companies. Contributing to the symposium on this topic, A. R. Cullimore, Newark College of Engineering, said in part:

> The policies and details of a placement program must be designed primarily for the development of individual students and the protection of their equities so far as continued professional life and development is concerned.
>
> The responsibility of the engineering college to society is discharged in general through the medium of the individual, not through the medium of the commercial venture with which the man happens to be connected.
>
> While some of our best procedures in education have been patterned from industrial procedures, it is possible that the colleges are so familiar with industrial techniques and so sensitive to market conditions and specifications with respect to their product, that they are unduly influenced in assuming certain industrial methods and practices. This is particularly true when such practices may be temporary and perhaps superficial.
>
> We should draw from industry with discrimination. We should accept many of their techniques, but it is not necessary in all cases to accept their philosophies. Nothing can harm us by accepting techniques and methods. It makes the whole matter flow much easier and without any particular difficulty, and techniques to us are not fundamentally important.

Four essential elements in the effective relationship of co-operative colleges and industry were suggested by Dean Kartak.

(1) An experienced and well poised Director of Industrial Relations who, by his personality and tact, is well received by those in industry with whom he deals, and

(2) Who will take the time and effort in his industrial relations to convince his co-operating industries of the right philosophy of co-operative training which will build for mutual benefit in long time relations, and who will tend to place too few rather than too many students in a given plant; in other words, who will help management by thinking on its side of the problem rather than on that of the school only.

(3) By planning a training program for the entire course from the standpoint of the employer so that the latter stands to benefit by absorbing annually a reasonable number of his trainees into his own organization.

(4) By providing a plan of employment and training which will, so far as possible, be automatically respected by both the employer and the labor organizations with which he deals.

Excellent contributions to the discussion were also made by H. P. Dutton, Armour Institute of Technology, who described the new co-operative courses at that institution and by G. R. Cowing who outlined the structure and functions of the General Motors Institute of Technology.

E. H. Flath of Southern Methodist University was elected chairman of the division for 1937–1938 with the understanding that he should choose his own secretary.

W. C. WHITE, *Secretary.*

ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY

The Division met twice in formal conference in addition to the dinner meeting, conforming to the program as published.

About one hundred were in attendance at the dinner, with a slightly smaller number registered at the conferences. In addition, an informal luncheon was held at the Harvard Union for the alumni of the 1929 Drawing School at Carnegie Institute of Technology, and the Summer Conference at the University of Wisconsin in 1936. Thirty postgraduates and freshmen mixed pleasure with business as new friendships were made and old ones renewed over that common denominator, the dining table.

At the business session on Thursday afternoon, the following officers were elected:

Chairman, John M. Russ; Secretary, H. D. Orth; Member Executive Committee, H. C. Spencer; Editor T-Square Page, Fred W. Slantz; Chairman Drawing Competition Committee, Arthur W. Leighton; Member Publication Committee, Frank A. Heacock.

Following the business session of the Division, the Executive Committee met, closed old business for the year and outlined the new projects to be developed in 1937–38.

JOHN M. RUSS, *Chairman.*

ELECTRICAL ENGINEERING

The activities of this Division and its members at the 1937 annual convention exemplified the engineering processes of analysis and recombination. In recent years the Society has been analyzing itself into divisions and subdivisions; now these components are realizing that they have important interests that are common to more than one. Of the five conferences, aside from the Division dinner, with which this Division was officially connected, four were joint conferences; and the Division was also represented by an important paper in one of the conferences of the English Division.

Suggestions made at the 1936 convention for a conference dealing with the newer mathematical tools at the disposal of electrical engineers developed into two of the joint conferences, both held with the Mathematics Division on Tuesday; one on Basic Mathematics for Electrical Engineering in the morning, and a second on Advanced Mathematics for Electrical Engineering in the evening. Reports of these will be made by the Mathematics Division.

Tuesday afternoon, the electrical laboratory and the library facilities of the Massachusetts Institute of Technology were explained by E. L. Moreland, Head of the Department, and Mrs. Ruth M. Lane, Librarian, respectively, and then inspected by the division, in guided groups under the direction of Professor C. E. Tucker. The laboratories of the Institute have, of course, long been known for the facilities and opportunities they offer for undergraduate and advanced study, but an authoritative outline of their organization and a trip through them are required to give anyone not regularly working in them a proper idea of the scope and extent of their resources for experimental study in all fields of electrical engineering. It is worthy of note that the students are not left to find their own way to the Institute's Vail library, but through regularly scheduled lectures and conferences, they are made aware of its facilities and the many uses that can be made of them in all branches of engineering and by students of all classes.

Wednesday afternoon was used for a symposium at Harvard on the objective and minimum content of non-electrical instruction, both technical and non-technical, in the electrical engineering curriculum. Henry G. Pearson, Head of the Department of English and History at M. I. T., discussed the English work under the title, What Price English, stating that with 25 man sections meeting 3

times per week, the cost of English instruction for the 600 freshmen is of the same order as the cost of the instruction in mathematics. The freshman and sophomore years are the proper times for most of the English instruction, but at M. I. T. most of the departments have requested at least another semester largely devoted to the construction of various types of reports. It is advocated that members of the staff of the English Department carry the same administrative and committee work as the staffs of the technical departments, and that proper superintendence and coordination be provided for all the "humanities," including English.

Hale Sutherland, Head of the Department of Civil Engineering, Lehigh University, investigating the extra-departmental courses of the students of his department and of the electrical engineering department, reported them so nearly alike as to raise the question of postponing all specialized courses, for departmental students only, until the third or even the fourth year for students in civil and electrical engineering and perhaps mechanical engineering. This should reduce administrative costs, increase the power of students to deal with fundamental concepts wherever and however applied and enlarge the opportunity for a sound training in the fundamentals of social problems.

R. L. Spencer, Dean of Engineering, University of Delaware, reported that a study of the catalogues of thirty-one institutions showed that the electrical engineering courses had from 24 to 51 credit hours (with an average of 36.4) devoted to subjects frequently offered by mechanical engineering departments. With a 144 credit hour curriculum this averaged approximately 25 per cent.

In the discussion which followed, Edwin C. Burdell, Dean of Social Sciences, Massachusetts Institute of Technology, pointed out that the electrical department staff had a responsibility in the motivation of the department's students into non-electrical subjects. Further discussion, principally relating to the matter of English, was contributed by Dean Spencer, Professor Beaver of Lehigh, and by Professor Sypherd, University of Delaware, who mentioned the advantages of having students practice writing and expressing themselves about the things that they are doing in the regular course work, instead of about unrelated matters.

This conference session was concluded with the election of the following officers for the next year: Chairman, H. W. Bibber, Ohio State University; Vice-Chairman, C. E. Tucker, Massachusetts Institute of Technology; Secretary, G. W. Swenson, Michigan College of Mining and Technology. These, with the junior past-chairman of the division and the chairman of the Educational Committee

of the American Institute of Electrical Engineers, and another member, to be appointed, constitute the Executive Committee.

This session was followed by an inspection of the extensive undergraduate and research laboratories in Pierce and Cruft Halls at Harvard, in guided groups, under the direction of Professor R. T. Gibbs.

Wednesday evening members of the division, ladies and guests to a total of 155 gathered in the North Hall of Walker Memorial for the Division Dinner, which was addressed briefly by A. M. McCutcheon, President of the American Institute of Electrical Engineers for the year just closing.

Thursday afternoon this Division joined in the Conference on Engineering Economy to discuss, among other things, a way to include the economic and business subjects in an engineering training by prolonging the period of organized study beyond the customary four years work in residence. A fuller report will be found in the report of the conference on Engineering Economy. At the same time some members dropped into the conference of the English Division to hear the discussion of an experiment in cooperation between the English and electrical engineering departments, which proved to be noteworthy for its time-saving and brain-stretching results.

A. A. Nims, *Secretary.*

ENGINEERING ECONOMY

The Engineering Economics Section held a very successful meeting July 1, 1937, the attendance being about one hundred. Eugene L. Grant of Stanford, Chairman of the Section, presided.

The first paper, Economics of Safety Engineering, by E. A. Holbrook, University of Pittsburgh, was favorably received although there was some difference of opinion among the group as to the necessity of a separate course on safety.

Professor Adams' paper, Introducing the Engineering Student to Recent Major Problems of Engineering Economy, stressed the value of such courses in helping engineers to form a sounder attitude towards social problems, which he feels, as engineers, they are better qualified to deal with than are laymen.

Dean Cobleigh, Montana State College, in his paper, Engineering Economy in Relation to Chemical Engineering Instruction, pointed out the possibility of integrating engineering economics with the technical courses, a problem which has been a serious one. He also expressed a desire to see a larger place in the curriculum given to the subject.

Professor Ayres of Wisconsin dwelt at some length on The Next Step in Engineering Education. This paper has aroused a tremendous amount of interest among engineering economics instructors and there is little doubt that the subject will be a live one for some time to come.

Hugo Diemer read a brief paper, The Relation of Shop and Factory Management to Engineering Economics, in which he agreed with Professor Ayres' general thesis but took exception to his inclusion of Factory Management in Engineering Economics, holding that it is a separate professional division.

Prepared discussions by Professors Eidmann of Columbia and Guild of Carnegie Tech were followed by a lively discussion from the floor among other things the lack of clarity and standardization of terminology in the field was stressed.

At a meeting of the Committee following the section meeting it was decided not to hold a meeting of the section at Texas A. & M. College in 1938.

GEORGE W. BARNWELL,
Secretary.

ENGLISH

The pending investigation of instruction in English in engineering colleges made the 1937 Conference on English one of unusual significance. The attendance was larger than usual, and numerous ideas for the investigation were presented. The first session, held on June 29, was devoted entirely to a round table discussion of plans for the investigation. President Hammond reminded the Committee on English of its responsibility in conducting the study, particularly in view of the generous subsidy from the Carnegie Foundation. He also made pertinent remarks regarding the desirability of limiting the scope of the investigation, and selecting for study institutions and individuals who had made important contributions to the methods of teaching English to technical students. The upshot of the discussion seemed to be that the weakness of present instruction in English centers around two facts: (1) the difficulty of obtaining satisfactory instructors from candidates developed under the present system of graduate training; and (2) the still greater difficulty of assuring to superior young teachers of English a satisfactory career in the engineering colleges. It was agreed that the present undesirable situation should be faced squarely and that a careful study of possible methods of giving to the teaching of English a dignity and importance comparable with the teaching of technical subjects or with the teaching of English literature in colleges of liberal arts is demanded.

The dinner meeting on June 30 was devoted to a consideration of the work being done by the Department of English and History of the Massachusetts Institute of Technology. Professors Howard R. Bartlett, Robert E. Rogers, and R. S. Woodbury presented various phases of this work. The group of teachers present, both teachers of engineering subjects and teachers of English, were impressed by the success of the Institute in building up a curriculum in English and the humanities which is suited to the needs of technical students and which at the same time has the possibilities of developing a vital culture. Disregarding the conventional courses in English of the ordinary college, the Institute has succeeded in formulating a plan that offers suggestions of great importance to engineering colleges elsewhere.

At the third meeting, held on July 1, reports on experiments were presented. O. A. Brown, Iowa State College, read a paper concerning a coöperative course conducted by the departments of English and electrical engineering at that institution which aroused a great deal of discussion about the fundamental position of a department of English in an engineering college, some teachers feeling that in combination courses the department of English almost necessarily becomes subsidiary to the technical department and consequently suffers loss of prestige which it very much needs, while others felt that such cooperation furnishes the best means of making work with technical students significant and effective. Other papers were Workable Methods of Correlation, prepared by W. H. Hildreth of the Ohio State University, which was read by Miss Harbarger of the same institution, and The Michigan Plan of Freshman Work in English, by Professor J. E. Thornton of that University. The Michigan plan showed considerable resemblance in purpose and method to that of the Massachusetts Institute of Technology. Professor Vaughan, University of Virginia, Editor of "English Notes" in the JOURNAL OF ENGINEERING EDUCATION, spoke vigorously on the necessity of making the "Notes" a vehicle for expressing candidly the opinions of persons concerned with the teaching of English so that the very real and disturbing problems may be frankly examined. This session closed with the formal recognition by the Conference of the service of the late General R. I. Rees to the cause of English in engineering colleges. A statement prepared by C. W. Park and Sada A. Harbarger was read and unanimously adopted.

H. L. CREEK.

GRADUATE STUDY

The conference on Graduate Study at the Cambridge meeting followed the official program, each paper being submitted as scheduled and then discussed by those in attendance at the meeting. The conference program was as follows:

1. What is graduate study in engineering? Thomas R. Agg, Iowa State College.

2. Are there valid reasons for conducting engineering graduate study in accordance with the traditional practices in the philosophical fields? F. Ellis Johnson, University of Missouri.

3. What are the criteria by which to measure the suitability of prospective teachers of graduate subjects? Joseph W. Barker, Columbia University.

4. How many institutions encourage high-ranking students to continue their studies beyond the baccalaureate degree? Clarence A. Pierce, Worcester Polytechnic Institute.

5. Specifications for the graduate thesis. Harold L. Hazen, Massachusetts Institute of Technology.

6. Graduate work through the medium of coöperative courses. E. B. Roberts, Westinghouse Electric & Mfg. Co.

7. Do the oral examinations of candidates for advanced degrees really serve a useful purpose? Hardy Cross, University of Illinois.

The discussion of the several topics presented in the formal and informal papers may be summarized as follows:

1. There seemed to be no valid reason for departing from the traditional methods of conducting graduate study. Division of the subject matter into majors and minors and sometimes with additional supporting subjects taken without graduate credit, supervision of the graduate work of the student by a faculty committee, written examinations for individual courses and oral examinations covering the thesis and general knowledge of engineering; all appeared to meet the approval of those who discussed these topics.

2. The conception of graduate study as a type of scholastic effort involving more difficult subject matter than required in the undergraduate curricula and greater responsibility on the student himself for his scholastic progress appeared to be general. It seemed to be the conviction that graduate work should become increasingly difficult in character and that the requirement of self-motivated accomplishment more exacting as candidates for the Doctorate than for candidates for the Master's degree.

3. There seemed to be a general opinion that teachers of graduate subjects should be selected on the basis of:

A. High scholastic attainment in the field to be taught.

B. Maturity in teaching experience as evidenced by the rank of associate or a full professor.

C. Adequate accomplishments in the field of research.

D. While there was little discussion of the question, some persons expressed conviction that advanced degrees should be a prerequisite to appointment to the graduate faculty.

4. The graduate thesis ought to be a formal report on the solution of a problem of such a character that it is reasonable to expect the student to complete the assignment within the time allotted. It appeared to be the opinion that the thesis might be of the fundamental research type, the analysis of operating characteristics of equipment or plants, the design of engineering works, or a critical study of an organization for management or operation.

INDUSTRIAL ENGINEERING

The Conference on Industrial Engineering was held at the Students' Astronomical Laboratory at Harvard University on June 30, 1937, with an attendance of 28. The following papers were presented:

The Technical School Prepares for Industrial Marketing, John R. Bangs, Jr., Cornell University.

Teaching Motion Economy, Myron A. Lee, Cornell University.

Technical and Business Options in Engineering Curricula, C. L. Eddy, Case School of Applied Science.

Trends in the Teaching of Management at M. I. T., Erwin H. Schell, Massachusetts Institute of Technology.

The Conference was called to order by its Chairman, Professor Norton of the Virginia Polytechnic Institute. Professor Norton commented briefly that he believed the Conference to be of primary interest to two groups: (1) those who are interested in formal curricula in management engineering; (2) those who teach management, either as options or electives, to engineers.

Industrial Marketing

In the last analysis, Professor Bangs stated, marketing processes and sales management become programs for analytical work, and the engineer is well qualified to do this type of work. To stress the importance of teaching marketing to engineers he cited an editorial which appeared in Industrial Marketing for May 1936 urging the introduction of marketing courses into engineering curricula. Professor Bangs next outlined a method of developing a course in Industrial Marketing for engineers. A special course, he stated, should include:

1. The basic principles of marketing which might be given as part of a course in management.

2. Industrial marketing which would deal largely with the products of engineering, durable goods, converted goods, and those materials with which the industrial firm is apt to be concerned.

As an outline for such a course the following was presented: (1) Market Research; (2) Product and Product Development; (3) Channels of Distribution; (4) Sales Organization; (5) Sales Management; (6) Sales Planning; (7) Sales Control; (8) Sales Compensation; (9) Pricing and Credit; (10) Service Features; (11) Advertising; (12) Sales Promotion.

Professor Bangs stated that considerable care should be taken in the presentation of material for a course in Industrial Marketing. He called the attention of the group to Professor Copeland's Reports, Volume IX, and several texts which might be used, among which were those of Professor Tosdal, Harvard Business School; Professor Elder of M. I. T., and that of Professor Converse. Professor Bangs pointed out that any instructor in Industrial Marketing should gather his own case material insofar as possible. To accomplish this, he stated, an effort should be made to interest market counselors in the course work; publishers, such as the Curtis Publishing Company, who have much material to offer; and, in addition, there should be research work done by one's own department.

In concluding, Professor Bangs stated that the introduction of marketing into the industrial engineering curriculum is a streamlining of the industrial engineering course by including a field with which the industrial engineer will be increasingly concerned.

Motion Economy

Professor Lee introduced his subject by demonstrating some applications of motion economy to daily tasks, and then presented some motion pictures to illustrate results of teaching motion economy; one example was taken from the college laboratory, and the other from industry. Professor Lee stated that a process of manufacturing, which is entirely repetitive, is not necessarily one in which the motions are well performed. He pointed out that motion economy can be used in many instances to improve these processes. Professor Lee demonstrated the application of micromotion or moving picture analysis work in teaching motion economy. He demonstrated also the application of charts in teaching motion economy.

At the conclusion of Professor Lee's paper and demonstrations, Professor Norton stated that the third and fourth papers would have to do with curricula arrangements, whereas, the first two had

to do with the teaching of particular courses. (Because Professor Schell was obliged to leave the city at a pre-appointed time, his paper was presented prior to that of Professor Eddy by permission of the latter.)

Trends in Teaching Management at M. I. T.

Professor Schell stated that the Massachusetts Institute of Technology has three phases of work to perform in teaching management:

1. The undergraduate curriculum in business engineering and analysis.
2. The graduate program.
3. The electives for all engineers which consist principally of service courses in business survey and accounting.

Professor Schell pointed out that M. I. T. does not propose to train industrial engineers, but administrators who are concerned with the external factors of business operations. He stated that the business and economic courses in the administrative program increase in number as the course progresses, and that the M. I. T. faculty handling this work keeps in mind that administration is a process of synthesis and analysis, which must have a completed round in the fundamental work of the more important industrial functions. Professor Schell stated that the business and engineering curriculum incorporates science, law, production, marketing, and labor, topped off with industrial problems of a synthetic nature. He added further that it had been found advisable to include introductory material in production in the sophomore year.

Professor Schell stated also that the business and engineering department is much concerned about the relations of engineers with government and sociological problems where coördination is necessary. He stated that all administrative options must include engineering and scientific material which meets the ideas and requirements of the heads of these other departments. He stated further that M. I. T. has an optional English consultation service, which is taken by 85 per cent of all engineers, who recognize that English is a "wrapper" for all ideas.

"Until recently," Professor Schell said, "our course gave students opportunity to choose their technical field in either the civil, the mechanical, the industrial, or the chemical option. For the coming year this choice has been reduced to work in the physical or chemical sciences. In short, we are neutralizing the problem rising out of the increasing complexity of engineering activity, by withdrawing into more basic and general areas. To compensate

for this trend toward fundamentalism in science and engineering, we are introducing wider latitudes of specific choice in business and economic subjects."

In closing, Professor Schell pointed out that the Institute is placing more emphasis on plant visitations, which are composed of small groups who make reports, hold conferences with accountants and other executives. These visits, he stated, are arranged by the students. In addition, dinner conferences are held to discuss business problems, and monthly conferences are arranged for graduate students. The Institute is continuing its industrial tours of Europe and in the classroom the Case Method is used where subjects permit.

Technical and Business Options in Engineering Curricula

Professor Eddy stated that the options at the Case School of Applied Science had been built on the idea that every engineer should have some business training. Surveys of the employment of Case graduates, he stated, indicate that 70 per cent of these men need business knowledge. Professor Eddy stated further that the business options are offered in the senior year as group options and occupy approximately one-half of the senior year, sixty per cent of the men taking the options come from the mechanical department.

Case School has adopted the practice of bringing in outside men to give some of the lectures in the business option courses, particularly in the fields of merchandising and purchasing.

Professor Eddy presented the group with mimeographed forms showing the arrangement and course content of the technical and business options at Case.

Discussion

The discussion period following the presentation of the papers was opened by Professor Norton, who spoke briefly on his attitude in relation to Bi-Lateral Options in engineering curricula. He stated that options in business and management are satisfactory if the entire course includes all the engineering fundamentals that an engineer should have. He stated that in his opinion it is a great problem to get the management and technical specialization arranged to prevent dilution of engineering fundamentals.

Professor Barnwell, Stevens Institute of Technology, asked Professor Norton at this point to express his views more completely. Professor Norton replied that he advocates a curriculum containing the engineering fundamentals as laid down by the Society for the Promotion of Engineering Education, Report of the Investigation of Engineering Education, Vol. I, page 88, and whatever else can

be added. Students following such a course, he added, should receive a degree descriptive of the type of course. Professor Norton stated further that all engineers should take a reasonable amount of engineering economy and management plus their specialization.

Colonel Diemer of LaSalle Institute supplemented Professor Norton's remarks by calling attention to what is now a distinct field in manufacturing, which requires special management training, and which has come to be called Industrial Engineering. In the other curricula, Colonel Diemer stated, business options are fine if they do not weaken the professional engineering course. He emphasized that there is a great distinction between the curricula to train the manufacturer and bi-lateral options. Colonel Diemer added that the Society for the Advancement of Management has made a survey which shows a large increase in industrial engineering curricula. These curricula offered by engineering schools give a large field for engineering specialization. In recognition of this he stated that the Society for the Advancement of Management has an operating vice president in charge of industrial engineering.

Professor Barnwell spoke again briefly to emphasize the importance of the training value of motion pictures as used in micromotion work in training students.

Professor Porter, New York University, stated that he wished to emphasize the employees' reactions to motion economy. He pointed out that in plants where motion economy has been properly introduced there have been no labor difficulties.

In answer to a question asked by Professor Theusen, Oklahoma A. & M., as to whether or not motion pictures are used to teach time study work, Professor Lee, Cornell, replied that they are and successfully so if suitable pictures are used. Professor Barnes, University of Iowa, stated that the uses of motion studies are just beginning to be realized. He cited instances where they are being used in hospitals to train nurses, in the handling of merchandise, in the marketing field, and in harvesting operations. Professor Barnes stated that the applications of motion economy are innumerable in machine design work.

Professor Guild, Carnegie Institute of Technology, commented that Industrial Marketing embraces more than the selling of industrial goods. He stated that even consumer selling involves considerable engineering. Professor Guild called the attention of the group to a text *Technique of Marketing Research,* by Wheeler, published by McGraw-Hill.

Professor Knowles, Northeastern University, commented that the program in Industrial Engineering at Northeastern includes a course called Sales Engineering which presents the principles of

marketing supplemented by several problems in both the industrial and consumer marketing fields. Students are obliged to prepare written reports designed to put across the selling of a product in much the same way that an engineer would have to persuade an executive through this medium to purchase some equipment or supplies. Professor Knowles stated that the arrangement of this course complied with suggestions made by industrial employers needing engineers who can make market analyses, see the need for products which they are selling, and put over the sale, both in writing and orally.

By way of comment, T. W. Prior, Goodyear Tire and Rubber Company, pointed out that many engineers can develop products but they are not sales-minded, that is, they do not conceive of the products from a sales viewpoint.

Professor Barnwell commented on Professor Schell's paper by calling attention to the danger of inflating the engineering student with respect to his becoming an executive. He remarked that he did not agree with Professor Schell's approach for training engineers. This training must be devoted to the fundamentals as opposed to training executives in college.

Professor Norton attempted to answer for Professor Schell in his absence, and stated that he felt sure that Professor Schell had in mind that his men would not become executives immediately but on the other hand would ultimately rise to executive positions. Furthermore, he stated, many M. I. T. men have opportunities open to them because of family contacts in industry which are not open to the average student in engineering colleges. Colonel Diemer added that a broad and social training such as is implied in what might be called the judgment course cannot be taught to men unless they are mature.

E. D. Ayres, University of Wisconsin, said that he felt that the group was confusing training in industrial engineering with training in business which leads to finance. In reply to Professor Ayres' statement, several comments were made to the effect that the ultimate result of training in both instances would be essentially alike.

In concluding the meeting, Professor Norton pointed out that industrial engineering has as much a definite aim as do the different technical fields in training engineers. He stressed the importance of the different conditions and attitudes as a constructive force in training men for different classes of work of which industry has great need.

ASA S. KNOWLES, *Secretary.*

MACHINE DESIGN

The first meeting of this Division followed the dinner meeting of the Mechanical Engineering Division. The subject discussed was What should the Undergraduate Machine Design Course of the Future Contain? Chairman Alex. W. Luce, Lehigh University, introduced J. Harland Billings, Drexel Institute, who then introduced the following speakers and subjects:

How Should the New Gear Design be Taught? Earle Buckingham, Massachusetts Institute of Technology.

The Contribution of Photo-Elasticity to Machine Design, John A. Prior and Professor Bates, University of Pennsylvania.

What Should the Undergraduate Know About Balancing and Vibration? C. W. Ham, University of Illinois.

The Place of Welding Instruction in the Machine Design Curriculum, C. H. Kent, Pennsylvania State College.

Instruction on Gages and Precision Measurement, J. Harland Billings, Drexel Institute.

Professor Buckingham showed by an illustration that the study of gear design requires the practical application of almost every phase of the broad subject of machine design and cannot be considered as an isolated case. Professors Prior and Bates explained the use of a model they had developed for demonstrating stress concentration, to their classes, and also showed that the qualitative use of photo-elastic studies was of considerable aid to the student in visualizing what takes place when machine members are under load. Professor Ham felt that some material on vibrations and balancing could well be included as a portion of a course in machine design, but thought that because of the limited time available that the greater portion should go in other courses or come in the Graduate School. Professor Kent said he believed there should be some assigned reading on welding in design courses and that some simple design problem should be used to indicate to the student the principles involved when designing for welding. This paper was discussed by Mortimer F. Sayre of Union College, who pointed out that re-design for welding in most cases meant a complete new design. Professor Billings explained the work done at Drexel in precision measurements, using the dial indicator, micrometer, Johansson blocks, the optical flat, etc. He showed the close relationship between a knowledge of how such measurements are made, and good design. It developed from the discussion, which followed the above talks, that much of the suggested material was covered in other courses in many of the colleges represented at the session.

The second meeting of this division was a joint meeting with the Mechanical Engineering Division.

The third meeting was held at Harvard University. Ward E. Bullock presented an interesting paper on Visual Aids in Teaching Machine Design. He described various models, and explained how he used them along with diagrams and lantern slides to clarify the thinking of the student. The second paper on Gear Design was given by Professor Earle Buckingham. He gave an informal talk on his experiences in the investigation of trying to find out what happens when gears are under dynamic loads.

The fourth meeting was a joint meeting with the group on Engineering Economy.

Henceforth the Division of Machine Design will become a subdivision under the newly formed Mechanical Engineering Division. The Executive Committee is Alex. W. Luce, Chairman, Lehigh; Edgar MacNaughton, Secretary, Tufts; C. W. Ham, Illinois; and V. M. Faires, Texas A. & M. The Chairman is to retire each year and a new member is to be elected annually, beginning in 1939 to continue a committee of only three in accordance with the plans of the Mechanical Engineering Division, Professor Luce will take over the editorship of the Machine Design Clearing House Bulletin. Its fee was set at fifty cents per year with a contributing membership fee of one dollar for those who wish to help.

The Division expressed its appreciation for the fine leadership given by Professor Eidmann and pledged its support in his future efforts with the Mechanical Engineering Division.

E. MacNaughton, *Secretary.*

MATHEMATICS

The first conference of the Mathematics Division consisted of three sessions, two of which were held in connection with the Division of Electrical Engineering. The third was partially used for the transaction of the business of the division. At this session H. B. Phillips, Massachusetts Institute of Technology, was elected chairman of the division for the year 1937–38, and Richard Burington was elected as a member of the executive committee for a term of three years. At the three sessions eight papers were presented and their contents discussed.

The first paper entitled Mathematics Required for the Electrical Engineering Curriculum at the Massachusetts Institute of Technology was given by Ernst A. Guillemin of M. I. T. This paper was a complete outline of the content of the basic course now given in planograph form in the department of electrical engineering, together with the mathematical requirements for the various topics of this basic course. According to the outline the basic course in electrical engineering included the following topics: Recapitulation

of the electromagnetic theory; calculation of the electric circuit parameters from the electric and magnetic field relationships; steady state and transient response of simple circuits; impedence and admittance functions of series and parallel combinations of circuit branches; impedance and admittance loci-circle diagrams; power; multi-branch linear networks; simple circuits with non-linear resistance or inductance parameters; the magnetic circuit; electronics; vacuum-tube circuits; energy conversion devices; poly-phase circuits; transformers; and machinery. The mathematics required in the discussion of the above topics includes the following: ordinary differentiation and integration; line and surface integrals; vector algebra and calculus with geometric and physical interpretations; Taylor's expansion of functions of a real variable; linear differential equations with constant coefficients; complex functions of a real variable; geometry of inversions in the complex plane; numerical and graphical integration; step by step integration; solution of differential equations by analytic integration and by successive approximations; Fourier's series representation for periodic functions; empirical functions; Poisson's equation; wave equation; symmetrical components.

In the second paper Harold Bibber, Department of Electrical Engineering at Ohio State University, discussed the mathematics needed for electrical engineering students in a state university. He considered three aspects of the subject, namely: (1) the instruction in mathematics that the electrical engineering student should receive; (2) the instruction he does receive; (3) the possible steps to more nearly achieve the desiderata.

Professor Bibber believes that the major emphasis in the work in mathematics should be placed on the development of ability to deal with physical problems; that the solution of such problems involves three major steps, formulation, manipulation and interpretation; and that more emphasis should be placed on formulation. He suggests that all students should cover the topics in the differential and integral calculus and that a selected group with demonstrated aptitude for mathematics be given an opportunity to continue their work in mathematics for at least another year, during which they should study advanced calculus, differential equations and vector analysis.

He offers the following criticisms of the present mathematical instruction, not all of which apply to a single institution. Topics have been taught with little or no continuity; work has been too formal; text books are not suited to the needs of engineering students; physical problems have received little or no attention; concept of function has been limited to one which can be written symbolically; the concepts of operation and operator have not received

proper emphasis; departments of mathematics in a state university have too many major concerns; too many of the instructors of engineering students have been young men working for advanced degrees in mathematics.

Finally he offers the following suggestions for improvement: improvement of the teaching of all engineering students during the freshman and sophomore years by a combined effort of all departments under the leadership of a standing committee of the college of engineering; the designation of a group of specially qualified and interested instructors in the department of mathematics to teach the engineering students; regular meetings of the instructors of mathematics together with representatives of other interested departments; improvement of the text-book situation; correlation of topics in mathematics with topics in related physics and engineering courses; exchange of instructors between departments; lectures at proper times by members of the staff of the department of mathematics to classes in electrical engineering on appropriate advanced topics; joint seminars; encouragement of advanced students in mathematics to take courses in engineering; representatives of the engineering college should be given an opportunity to express their views when new members of the staff of the department of mathematics are considered; sectioning of all mathematics classes according to achievement; influence the high schools to give a better grounding in mathematics to prospective engineering students; certain specific suggestions relative to content matter and presentation.

In the third paper entitled Mathematical Foundations for Modern Electrical Engineering, H. W. Bode, Bell Telephone Laboratories, Inc., stated the fact that the schools emphasize a limited range of topics in which the student becomes proficient. In his estimation this is not so important as training in relating physical situations to the mathematical analysis. In fact he would have the engineer learn certain special techniques after he is on the job and would make his mathematical training in school as general as possible. To accomplish this he suggested the following radical change in the present undergraduate courses in mathematics:

> The most appropriate foundation seems to be a course in the theory of functions of a complex variable replacing the present undergraduate curriculum. The course must necessarily be filled with practice material and with geometrical and physical illustrations, but it should follow the logical outline of function theory fairly closely. The power of function theoretic methods is so great that the essentials of the present field can be covered rapidly allowing time for further development of analysis.

He justifies this proposal (1) because of the fact that the theoretical foundations of electrical engineering are based directly

on the representation of the driving voltage as a complex quantity and (2) the theory of functions of a complex variable occupies a central place in mathematical theory and furnishes a broad foundation for specialized preparation.

In his paper, Some New Methods in Operational Analysis, Alan Hazeltine, Stevens Institute of Technology, discussed the properties of the operational calculus and its application to the solution of problems in physics. According to his analysis the operational calculus rests upon two ideas, (1) the separation of the symbols of operation from their operands and their treatment by the laws of algebra and analysis; (2) the reduction of all operands to the simple "unit function" of Heaviside. He pointed out the fact that the only operand in use is the unit impulse, which for differential problems is the first derivative of the continuous Heaviside function, and showed that operands may be reduced to unit impulses by the operation of superposition. He then discussed the properties of operators and showed the connection between an operational function and contour integrals, and finally illustrated the methods discussed by working a number of problems in electrical theory.

J. L. Barnes, Tufts College, in his paper Applicability of the Laplace Transformation gave a brief history of the development of the application of this transformation, showed its close connection with the operational methods already discussed by Professor Hazeltine and indicated its use in the solution of problems in physical analysis.

J. L. Synge, University of Toronto, made a plea for the development of The Missing Link Between the Engineer and the Mathematician, where the missing link is defined to be a man like Lord Kelvin with a thorough knowledge of mathematical analysis and a keen insight into physical problems. He thinks such training should be given to a specially selected group of young men, in order that a group of engineer-mathematicians may be developed, and that an institute for the training of such men would not be out of place.

A. Boyajian, General Electric Company, emphasized the Value of Tensor Concepts in Electrical Engineering. He pointed out the fact that tensor analysis has furnished more general and more powerful methods of attack on problems of electric circuits and electrical machinery. He then enumerated the following broader concepts and associated methods due to tensor analysis, (1) unity of an electrical system no matter how complex, and its expression in a single tensor equation; (2) interconnections of the parts of a system as constituting a physical transformation of coordinates; (3) concept of system kv-a as an invariant and its powerful utilization in transformations; and, (4) the concept of a rotating machine

as a generalized impedance network, and the application of Ohm's law and network transformation formulas to the calculation of its terminal characteristics.

S. H. Caldwell, Massachusetts Institute of Technology, explained the construction, purpose and method of operation of the Differential Analyzer in the solutions of differential equations.

J. H. WEAVER, *Secretary.*

MECHANICAL ENGINEERING

The recently organized Mechanical Engineering Division held a very successful series of meetings; the average attendance at each meeting 160. At the business meeting on June 28, the following officers were elected for the coming year: Chairman, F. L. Eidmann (Columbia), F. D. Carvin (Newark College), Secretary. Five committees were formed representing the main divisions of Mechanical Engineering. These committees will assist in forming a program for next year and in holding group conferences. The committees are (1) Heat Power, (2) Manufacturing Materials and Processes, (3) Machine Design, (4) Management, and (5) Experimental Engineering. The plan of organization presented by B. G. Elliott (Wisconsin) as chairman of the Organization Committee was approved. The Division voted to cooperate with the A. S. M. E. in developing an educational program for recent engineering graduates.

An interesting series of papers were presented and six group conferences were held. J. C. Hunsaker's (M. I. T.) paper on How is present day training of mechanical engineers to recognize the transition from the practical engineer of 25 years age to the applied scientist of to-day was well received. The paper reviewed the development of our undergraduate and graduate courses and stressed the need of more electives in the fourth year. Prepared discussions were presented by S. W. Dudley (Yale), H. A. Everett (Penn State), M. D. Hersey (Kingsbury Machine), D. B. Prentice (Rose Poly.) and M. J. Thompson (Mich.). The paper was also freely discussed from the floor.

On Monday afternoon, George A. Orrak delivered a paper on The Aims and Objectives of Mechanical Engineering Education. He emphasized the importance of fundamental instruction and the need of leaving the art of engineering to later years. The paper contains a good list of requirements for admission to an engineering course. Prepared discussions were presented by A. G. Christie (Johns Hopkins), V. M. Faires (Texas A. & M.), F. V. Larkin (Lehigh), R. L. Sackett (Penn State) and A. Sloane (M. I. T.).

The Mechanical Engineering dinner on Monday evening was attended by 200 members with about 50 more unable to be accom-

modated. Following the dinner, round table discussions were conducted by the various committees of the division.

On Tuesday morning, A. A. Potter (Purdue) presented a paper, Factors Contributing to Effective Teaching of Mechanical Engineering. His paper covered the desirable traits in a teacher. It created such a favorable impression on the conference that it was voted to recommend its publication in full.

On Tuesday afternoon, the division was honored by an address by President Compton of M. I. T., the subject of which was Who is a Good Teacher. The paper stressed the fact that there is no standard method of teaching and that a teacher must be judged by the results he produces. The next paper was presented by F. D. Carvin (Newark College) on A Fundamental Course in Mechanical Engineering. The paper reviewed the development of our present work and presented a four year schedule in mechanical engineering to represent the average course as now given. This average course was discussed and a modified schedule was proposed for consideration. Prepared discussions were presented by J. H. Billings (Drexel), H. O. Croft (Univ. Iowa), C. G. Thatcher (Swarthmore) and J. W. Zeller (Northeastern). The main point of discussion from the floor dealt with the proposed decrease in shop instruction.

The final paper of the conference was presented by F. L. Eid mann (Columbia) on Some Comments from Industry Regarding Present Training of Mechanical Engineering Students. The paper reported the result of a questionnaire and of personal visits to industrial leaders. The general opinion was in favor of a four year course of fundamental engineering instruction in preference to specialized instruction. The report also stated that industry seemed to favor the graduate of the four year course in preference to the post-graduate student. A more detailed report will be presented later.

The Mechanical Engineering Division proposes to publish in pamphlet form the various papers and discussions of the conference if enough orders are received to pay the cost of the publication. Please send your order to the secretary.

FRANK D. CARVIN, *Secretary.*

REPORT OF THE MECHANICAL ENGINEERING DIVISION ON THE ORGANIZATION AND ACTIVITIES OF ITS COMMITTEES

At the 1937 June conference of the S. P. E. E., the Division of Mechanical Engineering was organized under the following abstract rules:

1. The committees formed by the division are—

a. Manufacturing Materials and Processes. C. H. Casberg (Illinois), chairman; R. L. Sweigert (Georgia), Secretary; R. S. King (Georgia).

b. Heat Power Committee. C. H. Berry (Harvard), Chairman; B. G. Elliott (Wisconsin), Secretary; J. A. Dent (Pittsburgh).

c. Machine Design. A. W. Luce (Lehigh), Chairman; E. MacNaughton (Tufts), Secretary; V. M. Faires (Texas A. & M.); C. W. Ham (Illinois).

d. Management Committee. R. M. Barnes (Iowa), Chairman.

e. Experimental Engineering. J. W. Haney (Nebraska), Chairman; G. L. Tuve (Case), Secretary; J. A. Lambertine (Brooklyn Poly.).

2. The administration of the division shall be by an Executive Committee to be composed of the Chairman and Secretary of the division and the Chairman of the various committees.

3. Succession of office. The Chairman and Secretary of the division shall serve for one year and shall be elected from the list of retiring chairmen of the various committees. The committees shall be under the direction of a chairman, secretary and one other member. At the end of each year, the chairman shall retire and be succeeded by the secretary, who in turn shall be succeeded by the other member. A new member at large shall be elected by the committee.

4. All elections shall be at the time and place of the annual meeting.

Activities of the Committees at the Cambridge Meeting

Manufacturing Materials and Processes

The conference on manufacturing processes took up the subject of the teaching of heat treating and welding. Papers were presented by C. H. Casberg (Illinois) and O. M. Harrelson (Georgia). The material of these papers emphasized the trend in shop work from the old shop to the engineering laboratories, in which the emphasis is on the engineering aspects, the whys and wherefores. The new courses include such topics as welding, heat treatment, metallography; the effects of various processes on the properties of the materials such as hardness, strength and engineering applications. The experimental method seemed to predominate in these papers. Dean Stoughton (Lehigh) gave a discussion which emphasized the development of an understanding of the principles with the elimination of memorizing of facts which can be looked up in reference books by those who know how. He stressed the application of these principles to the solving of problems by the student.

R. L. Sweigert, *Secretary.*

Heat Power

The heat power conference, under the direction of C. H. Berry (Harvard), held a very interesting meeting attended by about 50 members. No formal papers were presented but an interesting general discussion was had on the content of the course and the methods of teaching. Various textbooks were discussed as to their value and help in presenting heat power material. The importance of heat transfer was emphasized and the meeting felt that this subject should be included in all heat power courses. A more close relationship between classroom and laboratory was felt to be desirable.

Management

The management committee was organized to act as liaison group connecting the Mechanical Engineering Division with the Management Division and other management committees. It is hoped that this will help stimulate work in this very important field.

Experimental Engineering

The Committee on Experimental Engineering was formed after considerable discussion as to the advisability of combining the work of this committee with that of the heat power group. It was finally decided to have separate committees. Laboratory methods were discussed and in particular, laboratory reports. It was felt that a formal report on every experiment was not necessary and it was suggested that more use be made of note book reports and other informal reports. Considerable discussion was had on the subject of group experiments against individual student experiments. It was felt that the latter type of experiment was the more desirable although it was recognized that certain experiments required the services of a group of students. The meeting was attended by about 25 members and was under the direction of J. W. Haney (Nebraska).

MECHANICS

The first meeting of the Division of Mechanics was a joint session with Civil Engineering, L. E. Grinter, presiding. Two papers were presented, Educational Inflation, by Hardy Cross, and History of Some Concepts of Mechanics, by Jasper O. Draffin, University of Illinois.

Professor Cross cited the dangers which might arise from the indiscriminate addition of undergraduate courses to the engineering curriculum. Lack of timeliness, with specialization at the expense of training in synthetic thinking, and digression from the main objective of undergraduate teaching are too frequently the result of trying to increase teaching effectiveness merely by means of inflating the curriculum.

In his paper, read by Professor Seely, Illinois, Professor Draffin justified the subject by pointing out that the most effective engineer is the one who knows the culture, the background of his profession. He then showed how the concept of equilibrium and of motion developed and was influenced by the thought and spirit existing in the different eras. The Babylonians and Egyptians had a practical knowledge of equilibrium, but, as far as we know, no mathematical knowledge. Since the Greek scholars considered themselves above experimentation, their contributions were negligible. The Romans concentrated their efforts on government and war. Mechanics remained stagnant throughout the Dark Ages, and then made brilliant gains from the 16th to the 18th Centuries. In fact, disregarding

Archimedes' work, practically all of the principles of mechanics were elaborated in a period of less than 160 years. Since the developments of the Renaissance the applications of the principles of mechanics to engineering have been made steadily.

The Mechanics Division then met separately with H. J. Gilkey, Iowa State, presiding in the absence of the scheduled chairman—attendance 47. Four papers were presented: Aids in Teaching Mechanics, by E. W. Rettger, Cornell; Realism in Teaching Mechanics, by W. J. Cox, Yale; What Departments Teach Mechanics?, H. J. Gilkey and F. E. Lightburn, Iowa State, and A New Method of P + Q Determination in Photo-Elasticity, by G. H. Shortley and Royal Weller, Ohio State.

Professor Rettger stressed the importance of creating mutual good feeling between instructor and students. Knowledge of subject matter, technique of presentation, sympathy without familiarity and avoiding sarcasm and an attitude of superiority were cited as important factors in creating the proper student-teacher relationship. Simple demonstrations which enable the student to visualize the fundamentals in operation and to correlate them with mathematics aid in promoting an understanding of the subject material. Professor Rettger stated that he considered experimental verification or the physical representation of the theorems of Mechanics essential. If regular laboratory work is not possible, a demonstration lecture at intervals would help.

Professor Cox emphasized, in citing an example from his student days, the insight to be gained into the limitations and difficulties of the applications of the principles of mechanics as well as to stimulus to be derived from computation problems done in the field—working directly from an actual structure. He described how use was made of nearby garages and equipment in laboratories in providing practical, realistic problems in the courses at Yale. Careful thought must be given to the selection of the problems.

The next paper contained a tabulation of 133 engineering colleges in the United States indicating in which departments the undergraduate courses in statics, dynamics, strength of materials, materials laboratory, properties of materials, hydraulics, and hydraulics laboratory were taught, and the time allotted to each. Thirty-five colleges have separate department of mechanics. In many of the other schools the civil engineering and mechanical engineering departments teach most of the mechanics.

Mr. Weller described the use of an algebraic process which may be used instead of one of the more difficult experimental methods of determining the P + Q stresses in photo-elastic models.

The Mechanics Conference met with Civil Engineering in a joint session with H. J. Gilkey, presiding. The topic for discus-

sion was Should the Course Content of the Mechanics of Materials be Varied to Meet the Special Needs of Such Subsequent Courses as Machine Design and Structural Engineering?

V. M. Faires, speaking from the standpoint of machine design, presented the first paper. He stated some advantages might be derived by emphasizing in the primary course those fundamental ideas which are referred to incidentally or not applied at all in the secondary course, but pointed out that this would require separating the civils from the mechanicals for the structural and machine design aspects. He suggested that such topics as stresses on oblique sections, deflections, energy absorbing capacity of materials, Poisson's ratio, vertical shear and the analysis of statically indeterminate beams be emphasized since they receive little attention in subsequent courses. The student should, of course, also receive thorough training in topics such as flexural stresses in beams, stresses in shafts, combined stresses, and columns.

In the second paper Frank Kerekes, Iowa State, discussed the question from the viewpoint of the structural engineer. He compared the requirements for subsequent structural work with the topics covered in strength of materials and found them to be in agreement. The needs of the student in structural engineering were summarized as follows: "The student who starts his structural courses with a clear understanding of the resolution, composition and equilibrium of forces, who can visualize the various physical constants and properties of engineering materials accurately, who possesses real physical conceptions of the behavior of beams and columns, and who has assurance and skill in working with the elastic curvature equation, will apply himself creditably to the mastery of the practical applications to structural engineering."

Brief discussions of the papers were given by S. W. Dudley (Yale), J. A. Orr (Texas A. & M.), and M. O. Withey (Wisconsin).

A separate meeting of the Mechanics Division followed, presided over by Professor W. R. Cornell, Cornell University. Attendance 51.

J. S. Peck, City College of New York, presented a paper entitled The Aims and Objectives of the materials Testing Laboratory in which he described the course which has been evolved at C. C. N. Y. The objectives of the course are, as stated, "The attainment of an understanding of the physical properties of materials, including their behavior under stress, and the attainment of the ability to *use* the understanding. . . ." The principal difference between this and other laboratory courses is that the students are given no definite instructions for performing specific experiments. They are given general directions for each type of test, and each squad is

assigned a material to investigate. The squad decides upon the necessary tests, and upon approval of the instructor, conducts the investigation and reports upon the results. The study of six materials constitutes a minimum term's work. In the discussion which followed, it developed that mechanics of materials is a prerequisite for the course which meets once a week for a three-hour period. Three men are assigned to a squad, three squads to an instructor. The reports, for which there is no standard form, are written outside. The grade allotted is on the basis of examinations of the true-false and objective type, and on attitude, performance, and improvement.

In a paper entitled Graduate Work in Mechanics J. P. Den Hartog, Harvard, outlined a 4-unit graduate course consisting of engineering calculus; structures; elasticity, plasticity, and photoelasticity; and dynamics and fluid mechanics. Subjects suggested for additional work were plasticity and theories of failure, photoelasticity and analogies, elastic stability and thin plates, lubrication, vibration, seepage and water flow, supersonic flow and ballistics. He indicated the necessity of avoiding replacement of fundamental topics with those which might be of but temporary importance.

Fluid Mechanics by S. R. Beitler, Ohio State, was presented. Professor Beitler cited the number of courses in which some fluid mechanics was taught or was required as prerequisite, and recommended a general course in fluid mechanics to eliminate duplication. A written discussion prepared by M. J. Thompson, Michigan, was read by R. A. Dodge, Michigan. It indicated wholehearted agreement with the advisability of introducing a fundamental course early in the curriculum. The purpose of such a course should be to provide the student with a basic knowledge of fluid motion. Applications of theory are secondary in a beginning course.

A paper entitled An Integrated Course in Dynamics was read by F. L. Singer, New York University. He compared the order of subject matter in nine texts as dynamics and suggested a revised order in which each type of motion (translation, rotation and plane motion) be dealt with separately, considering its kinematics, kinetics, and the application of work-energy and impulse-momentum to that type of motion before proceeding to the next type of motion.

Dean-elect H. M. Westergaard, Harvard, was the guest speaker at the annual dinner and addressed the group on Arguments for This and That. C. T. Olmsted, Michigan, and W. B. Johns, Georgia Tech., were elected to the Executive Committee of the Division.

GLENN MURPHY, *Secretary.*

MINERAL TECHNOLOGY

The mining and metallurgical branches of engineering education were represented by a group of about thirty at the forty-fifth annual meeting of S. P. E. E. at Cambridge June 28–July 2. An important step was taken in changing the status of this group by the formal organization of a Division of Mineral Technology, replacing the former Mining and Metallurgy committee. A resolution was adopted asking the Council of S. P. E. E. to recognize and approve the creation of this new Division, and the Council subsequently acted favorably on the request. Accordingly the field of mineral technology is now on the same basis as each of the other major branches in S. P. E. E. The coöperation of all members of the Division is needed in making its activities commensurate with those of other divisions, as well as in increasing the membership of the Division. A good beginning is indicated by the interest shown at the Cambridge meeting.

The resolution of organization provided that the Division of Mineral Technology shall embrace engineering education in the following fields: mining, metallurgy, mineral dressing, petroleum and natural gas production, ceramics, geology, fuels utilization.

The committee which met to formulate the resolution and to nominate officers for the coming year was chosen to include representation from all of the above fields. It consisted of W. B. Plank (Lafayette), Chairman; Richard S. McCaffery (Wisconsin); T. T. Read (Columbia); H. T. Mann (M. I. T.); and A. F. Greaves-Walker (North Carolina). The resolution was adopted by the whole group at the dinner meeting held subsequently, and the officers nominated were elected. The following officers were elected: Bradley Stoughton, Chairman; A. F. Greaves-Walker, Vice-Chairman; Allison Butts, Secretary.

The program under the Mining and Metallurgy Committee for the Cambridge meeting was arranged under the leadership of W. B. Plank, Chairman. The first session, with Professor Plank presiding, was held in Rotch Hall at Harvard on Wednesday afternoon. The meeting was first addressed by H. P. Hammond, who had been asked to discuss the problem of organizing the new division and the need for this step. The privilege of receiving the counsel of the new president of S. P. E. E. was much appreciated. Professor Plank also spoke on the subject and in particular discussed the question of coöperation with the Mineral Industry Education Division of the American Institute of Mining and Metallurgical Engineers, of which he is chairman. He and others expressed the view that the activities of the two divisions would supplement each other without duplication of effort or of program.

A paper on "Aims and Objectives of Metallurgical Engineering Education" was then given by G. E. Doan, Lehigh. The paper was a plea for liberalization of engineering curricula. Most engineering teachers have long favored such liberalization in principle, but find difficulties in practice. Many of those present took occasion to give their views of the difficulties and ways of meeting them in the extended discussion which followed the paper. The chairman called on Bradley Stoughton, Lehigh, A. F. Greaves-Walker, North Carolina, E. A. Holbrook, Pittsburgh, T. T. Read, Columbia, and H. T. Mann, M. I. T., to discuss the question from the standpoints of the curricula of metallurgy, ceramics, mining, and petroleum.

Professor Greaves-Walker presented his views in a paper entitled, "Educational Problems in Ceramic Engineering." His paper appears at the end of this report.

The group met again for dinner at the Harvard Faculty Club. This was a very enjoyable occasion, arranged by C. E. Locke, M. I. T. Dean Holbrook presided, and 23 members were present. A talk was given by E. M. Stephens, Assistant Personnel Manager of the United States Steel Corporation, referring particularly to the problems of placing mineral technology graduates in industry. An early adjournment was necessitated because of the Pops Concert in the evening. The entire week will be remembered for its profitable program, pleasant associations, and the fine facilities for the huge convention afforded by the hosts, Harvard and M. I. T.

ALLISON BUTTS, *Secretary.*

EDUCATIONAL PROBLEMS IN CERAMIC ENGINEERING

BY A. F. GREAVES-WALKER

Professor of Ceramic Engineering, University of North Carolina

It was not until the Engineers Council for Professional Development began its accrediting program that the ceramic engineering educators awakened to the fact that their field and its extent was little understood, even by the educators in other fields of engineering. When they discovered, to their chagrin, that chemical engineers had been assigned to audit the departments of ceramic engineering, on the assumption that ceramics was a "phase" of chemical engineering, they immediately reached the conclusion that it was time to begin a campaign of education.

The first department of ceramic engineering was established at The Ohio State University in 1895 which is several years before the first department of chemical engineering was thought of. This department was headed by a mining engineer, Brigadier General Edward Orton, Jr., at that time State Geologist of Ohio and later Dean of Engineering at Ohio State. The first degree given was

E.M. in Cer.E. Within a few years the E.M. was dropped. The training of the founder and the original degree, coupled with the date of establishment of the first department, should remove any doubt as to ceramic engineering belonging to the mineral technology group.

Ceramic engineering has, by some engineers, been designated as a specialized branch of engineering, and by others, among them mining engineers, some doubt has been expressed as to whether a degree in ceramic engineering is justified.

To these it can be said that at the time the department at Ohio State was organized the mine engineering departments were paying practically no attention to the mining and refining phases of the vast non-metallic field, except coal, and none whatever to the processing phases. The field was virtually unoccupied so far as engineers of any kind were concerned, and even now there are very few, other than ceramic engineers, in many of the branches of the field included in ceramics.

For all practical purposes it can be stated that the mining and metallurgical engineer mines, refines, and processes the metallics, while the ceramic engineer mines, refines, and processes the nonmetallics. The definition of ceramic engineering adopted by the ceramic engineers and accepted by E. C. P. D. is as follows: "Ceramic engineering is that branch of engineering which is concerned with (1) the mining, refining, and processing of minerals and rocks excepting coal and oil, and ores as such; (2) the manufacture of products therefrom; (3) the design and construction of the necessary equipment and structures.

Obviously if this definition is accepted there can be nothing specialized about ceramic engineering, and in the opinion of the ceramic engineer, his branch of engineering is just as basic as mining, metallurgy, civil, chemical, or any other.

It will be evident to this group that the problems of the ceramic engineering educators are much the same as those in mine and metallurgical engineering. As is the case with mine engineering, there has been a gradual separation of engineering from technology which has resulted in some departments substituting so many technology courses for engineering courses that there is a question whether or not their graduates are engineers or technologists. This question E. C. P. D. will soon settle.

As in mine engineering the ceramic engineering field of knowledge has expanded to such an extent in recent years that it is becoming increasingly difficult to do justice, within the time limits, to the strictly ceramic subjects and also meet state registration board requirements in other branches of engineering, to say nothing

of the increasing demand for more time to be devoted to the humanities.

The ceramic engineer requires a thorough grounding in mathematics, chemistry, including physical and thermo-chemistry, physics and geology. The state registration boards' requirements make it necessary to give strong courses in mechanics, mechanics of materials and design, with emphasis on structures, and also something more than elementary courses in mechanical and electrical engineering and surveying.

In order to fit graduates to enter any one of the many and varied ceramic industries, they must devote at least a limited amount of time to their specialty. It is customary to require the completion of a research project and a thesis and this, if done well, requires considerable time in the senior year.

As in practically all mineral technology curricula, ceramic engineering must have a minimum of two years of chemistry, two years of geology, and some metallurgy and metallography, all subjects which are not generally required, at least in the above amounts, by other branches of engineering.

So far no mention has been made of economics and the humanities. Ceramic educators realize, as do others, that in order to develop leaders these subjects must be included in all engineering curricula. To find time to include a sufficient amount in a four year curriculum to be of service to the graduate is our stand-out problem. There seems to be no other answer than a five year curriculum.

In the institution which I represent 246 term credits or 164 semester credits are required for an engineering degree; but even with this unusually high requirement, it appears impossible under present conditions to give the graduate the training in the essentials which today's world demands.

PRE-COLLEGE GUIDANCE IN ENGINEERING

Much interest was shown by a group of about fifty engineering educators that attended a discussion on this subject as part of the program of the S. P. E. E. convention. R. L. Sackett was the chairman of the session and W. B. Plank the secretary.

Dean Sackett described the study of the E. C. P. D. in methods of predicting success of engineering college students by means of English and mathematics tests. He also told of the activities in guidance being conducted by engineering groups in various parts of the country.

Jerome V. Howe, Worcester Polytechnic Institute; W. B. Plank, Lafayette College; and J. W. Barker, Columbia University, summarized the results of pre-college guidance activities of their re-

spective institutions. Of special interest were the remarks of J. A. Lowd, a sophomore of Worcester Polytechnic Institute, who attended the Worcester Polytechnic Institute Techniquest in 1936 and who told of the help he derived therefrom.

Dean Barker also described his university's program of giving engineering guidance information each year to a group of secondary school teachers taking summer courses at Columbia.

It was stated that the results of these activities in the three institutions have proved the soundness of the idea. They were effective means of aiding boys to make proper choices of their life work. Through the close personal contact with and instruction from experienced engineers, engineering educators, psychologists and counselors, the chances of making the wrong choice have been greatly minimized. Many boys have been helped in choosing non-engineering fields, and the results of the guidance as evidenced by achievement in college thus far have been on the whole, quite satisfactory.

W. B. PLANK, *Chairman.*

PROFESSIONAL STATUS AND EMPLOYMENT OF ENGINEERING GRADUATES

Ovid Eshbach, American T. & T. Co., presided at the first session which opened with a lucid Summary of Previous Meetings by Howard Davis, New York Telephone Co. Particularly valuable were the careful papers on College Interviewing under Changing Economic Conditions jointly prepared from the viewpoint of the colleges by John R. Bangs and J. R. Moynihan of Cornell; from the viewpoint of industry by M. M. Boring of the General Electric Co. These were discusssed with vitality and candor. The chairman appointed a committee of six, three from industry and three from the colleges, to draw up resolutions embodying the major conclusions of the afternoon. These were to be brought in for discussion at the evening session and for later presentation to the general conference.

John R. Bangs, Cornell, presided at the scond session where E. S. Burdell, M. I. T., presented his ideas on Educating Engineers to Meet their Social Responsibilities. Following the discussion of his paper, the Committee on Resolutions made the following report. Whereas it is the consensus of opinion of this meeting that the best interests of the recruiting industrial organizations as well as of the students themselves can thus best be served, be it now resolved:

(1) That every effort be made to remove any emotional pressure which may cause a boy to make a hasty or an unwise selection of employment.

(2) That every effort be made for complete coöperation and mutual information between both the college placement office and industrial representatives themselves for the purpose of placing each man in his right job.

(3) That every industrial representative immediately furnish the college placement office with the names of students in whom they have become seriously interested as possible empolyees.

F. ALEXANDER MAGOUN, *Secretary.*

PHYSICS

The activities of the Physics group consisted of two formal conferences, one held at Harvard, the second at Massachustettes Institute of Technology—programs of which have already appeared in Society publications—an inspection trip over M. I. T. under the guidance of Professor Sears, an inspection trip over Harvard under the leadership of Professor Black, a night visit to the Harvard observatory under the direction of Professor Joseph Boyce, and a dinner conference at the Harvard Union. Each component part had been well planned and was most thoroughly enjoyed by some forty representatives who attended. At the formal conferences, papers aroused considerable discussion, particularly the conference on Industrial Physics. Of especial interest was a discussion on the effect of the recent E. C. P. D. inspection on courses in physical engineering.

It was the consensus of opinion that "the meetings were most enjoyable and helpful in many ways."

D. S. ELLIOTT, *Chairman.*

SECTIONS AND BRANCHES

Due to Professor Thatcher being on a Sabbatical leave during the school year 1936–1937, a change was made in the Chairmanship of the Committee and a few changes in its membership. The former committee had under way several good projects and efforts were made to press them forward during the year.

Professor Thatcher's committee did yeoman service for the Society in the establishment of Sections. The map published in the October, 1936 JOURNAL showed only four undeveloped areas remaining—Upper New York State, New Mexico, Maryland, and North Dakota. Plans which are under way to establish sections in the first three of these areas should be consummated before the 1938 Annual Meeting.

The Section has proved to be an effective type of organization and reports indicate that with few exceptions interest in section meetings is increasing. Those not reporting an increase in interest report that it is being maintained. The Branch has not proved

to be so successful, due usually to the multiplicity of group meetings on a single campus. There are branches, however, that have prospered and the reason seems to be that they have had year programs in which different angles of a single topic have furnished programs for meetings, and this continuity of interest throughout the year has supplied the incentive needed to keep the branch in continuous operation.

A plan for local meetings without the formal organization of a branch that has been tried at a number of institutions during the year is to set aside an enginering faculty meeting in the fall to hear the reports of the delegate of the institution and other members who attended the annual meeting of the Society and a like meeting in the spring to review the program of the annual meeting that year so that the delegate and others who plan to attend can determine the interest their colleagues have in the topics to be discussed. These meetings should promote interest in the Society among the engineering faculty members and guests invited from associated departments.

There seems to be a strong desire to have officers of the parent society participate in the programs of the annual meetings of sections. The Society has had no item in its annual budget for the traveling expenses of someone so qualified to appear on these programs and its officers feel that it has not been wise to include such an item. Members of Council might meet this demand by attending section meetings in their respective areas.

Attention was called last year to the need of assistance in the administration of sections to the extent, at least, of the collection of dues. It was suggested that these dues might be collected along with those of the Society. The idea for some form of subsidization by the parent society was proposed to the Council at the Cambridge meeting, but was not favorably received. The collection of dues has been found burdensome by several of the secretaries of sections and this condition should be met as painlessly as possible. The success of a section is usually dependent upon the attention given it by a well qualified secretary over a period of years and when his duties become distasteful this continuity of service is broken by resignation and the continued success of the section endangered. This problem should be given further study by the Committee with the hope of finding an acceptable solution.

At the Cambridge meeting the Committee held a conference in which the program was designed to:

(*a*) Hear from as many sections and branches as possible.
(*b*) Locate some of the problems in the operation of sections and branches.

(*c*) Get reports on topics, programs and administrative practices that should be helpful to officers of sections and branches responsible for the operation of these divisions of the Society.

Space does not permit of a complete report of the conference in the JOURNAL, and since it was largely an experience meeting an abstract will be mailed secretaries of sections and branches for the use of officers directly interested.

The principal speakers were:

Carl S. Ell, Chairman, New England Section.
H. W. Bibber, Chairman, Ohio Section.
W. S. Rodman, Chairman, Southeastern Section.
R. Norris Shreve, Member Executive Committee, Illinois-Indiana Section.
G. P. Boomsliter, President, Allegheny Section.
Franklin O. Rose, Secretary-Treasurer, Pacific Southwest Section.
R. C. Kintner, President, Bucknell Branch.
F. W. Slantz, Chairman, Lafayette Branch, 1936.
Roscoe W. Morton, President, Colorado School of Mines Branch.
Albert A. Nims, Representative, Newark College of Eng'g. Branch.
W. S. Evans, Representative, University of Maine Branch.
L. W. Hitchcock was Secretary of the Conference.

GEO. W. CASE, *Chairman.*

TESTS AND COMPREHENSIVE EXAMINATIONS

The committee met for noon-luncheon at the Harvard Faculty Club. The luncheon was attended by some 20 persons, including membership of the committee and others interested. It was the consensus of opinion at this luncheon that there would be many advantages in having a Division of Tests and Comprehensive Examinations established under S. P. E. E. This matter was considered as the main business of the 2:00 P.M. conference, and a plan for the organization of such a division was presented to the S. P. E. E. Council on Thursday by Professors W. H. Timbie, George B. Thom and Dean Paul Cloke. The petition was laid on the table.

The regular meeting of the conference was called at 2:00 P.M. by C. V. Mann, with about 40 persons present. W. H. Timbie of M. I. T., and last year's Chairman of the Committee, was invited by Chairman Mann to conduct the program of the conference.

Under the heading of "Committee Report," C. V. Mann reported that the committee had been unable to carry out the program planned for the year by reason of the fact that assignments to committee membership were not made in accord with the wishes and plans of last year's conference. Also that no financial assistance could be procured.

The following papers were presented:

The Status of Comprehensive Examinations in the Professions, by Edward S. Jones, Buffalo University.

Types of Examinations Administered by the Michigan State Board of Examiners, by C. T. Olmstead, University of Michigan.

Discussion of Present Usage of Sophomore Comprehensive Examinations, by George B. Thom, Swarthmore College.

Correlation Studies Between Comprehensive Examination Scores and Accumulative Averages for Sophomore and Senior Years, and Freshman Week Tests at University of Maine, Paul Cloke, University of Maine.

General Effectiveness of Sophomore Comprehensive Examinations at Lehigh University, Bradley Stoughton, Lehigh University.

Round Table Discussion. The Comprehensive Examination in Engineering Education. Led by Richard H. Frazier, Massachusetts Institute of Technology. The following persons took part in the discussion: Dail of Pratt Institute; Cloke of Maine; Charles Gus of New York University; E. S. Jones of Buffalo; Miller of Michigan State; Turner of Yale; Stoughton of Lehigh. The round table was closed by Professor Frazier who summarized his own ideas and those of the conference. A similar conference is planned for next year's annual convention.

C. V. MANN, *Chairman.*

TWO-YEAR TERMINAL PROGRAM.

The Committee met at the Harvard Faculty Club and spent much time discussing the question and reached the following conclusions:

1. To endeavor to secure a place on the general program of the next annual meeting of the S. P. E. E. and at that time to invite Dean W. R. Woolridge of Texas and W. R. Work, Head of the Department of Electrical Engineering, Carnegie Institute of Technology, to present papers.

The Committee approved the coöperation with the Office of Education in circularizing the institutional members of the S. P. E. E. relative to the present status of two-year terminal programs in engineering, and the form and questions in this proposed questionnaire were discussed. Those agreed upon are as follows:

PROPOSED QUESTIONNAIRE ON TWO-YEAR TERMINAL PROGRAM

(Please return this questionnaire as promptly as possible to Office of Education, Washington, D. C.)

I. What special or unusual arrangements have you for terminating the work or attendance of engineering students at your institution before graduation?

(*a*) Do you give a certificate?

(*b*) Please send catalog, descriptive material or rules and regulations governing this terminal program.

(*c*) When was the program put into effect? Date .....

(*d*) What is the enrollment?

II. Do you consider it satisfactory and a success?

III. What are its chief advantages?

IV. What are its chief defects or difficulties?

V. In the event a student shows unusual vocational or manual aptitude but cannot adequately master the theoretical work required of engineering students, what do you do to help him or place him?

(*a*) What vocational courses do you offer and for what positions do they train men?

(*b*) How many such students do you have?

VI. Of your entering freshman class, approximately what percentage graduate four years later?

VII. Have you any data or studies showing what becomes of those who drop out?

(*a*) If not, what do you *think* becomes of them?

VIII. Is your state or region adequately served with Trade Schools or means for vocational education?

IX. Do the Junior Colleges in your region assist in the solution of this two-year terminal problem?

(*a*) Are their courses adequate?

(1) In subject matter.

(2) In laboratories and facilities for practical work.

Although most members of the Committee found that the Junior Colleges in their respective sections had not made a material contribution to this problem, B. M. Woods of California reported that they were very live and influential agents in terminating students in the State of California.

The Committee adjourned instructing the Chairman to request the continuation of the Committee and to coöperate with the Office of Education in assembling the necessary data for our future study.

B. R. Van Leer, *Chairman.*

THE FIRST SURVEYING TEACHERS' CONFERENCE

By JOHN S. DODDS, Iowa State College

AND PAUL P. RICE, Lafayette College

The first Surveying Teachers' Conference, under the auspices of Committee 8—Surveying and Geodesy, Civil Engineering Division, was held July 25 to August 5, at Camp Marston, of Iowa State College, located on Rainy Lake, 35 miles east of International Falls, Minnesota. To arrange this Conference a special committee was appointed by Vice-Chairman Otto S. Zelner, University of Minnesota, at the 1936 Annual Meeting of the Society held at Madison, Wisconsin, as follows: Brother A. Leo, Manhattan College; Ray S. Owen, University of Wisconsin; F. W. Welch, State College of Washington; Paul P. Rice, Lafayette College; and John S. Dodds, Iowa State College, Chairman. Professor Dodds, Director of Camp Marston, acted as manager and host.

The Conference was attended by 31 teachers of surveying, representing 26 institutions throughout the country. Wives and children in camp numbered 24. Invited speaker guests, present for several days each, were: H. M. Dibert, W. & L. E. Gurley; M. S. Jordan, Chicago Rep., Buff & Buff Co.; and M. Y. Poling, Consultant, Governmental Projects Section, W. P. A. The staff, which included Dr. H. L. Johnston, medical officer and family; Miss Jean Cole, secretary; four students and camp assistants; and two cooks, numbered 13. The total number in camp was 71.

One of the highlights of the Conference was the preparation and approval of minimum essential course contents which are presented to the profession by committees with the following statement:

MINIMUM REQUIREMENTS FOR SURVEYING COURSES

It is realized by the members of the Conference that local conditions and the possible availability of more time than has been contemplated in the formulation of these statements may make desirable the addition of other items to the surveying courses in individual colleges. The lists were prepared wholly with the idea of being suggestive to administrators of engineering colleges and to others responsible for curricula in surveying.

The members of the Conference were unanimous in the belief that surveying merits an even more important position in engineering curricula than it is now given in many institutions, and believes

that instruction in surveying, in addition to its vocational training, provides much of general educational value; and that it should be given with both of these aspects in mind. The Conference members acknowledge and emphasize to others that there are items omitted from the statements of "minimum essentials" which are valuable and may properly be included in the surveying courses at specific engineering colleges. The appended statements have been largely restricted to items valuable for surveying instruction and which at the same time are contributions to a fundamental engineering training.

T. C. ADAMS, *Chairman,*
A. H. HOLT,
J. C. PARK.

ELEMENTARY SURVEYING FOR NON-CIVILS

1. That an elementary course in surveying be required of all engineering students.
2. That greater emphasis be placed on licensing or registration laws, ethics and professional practice.

MINIMUM COURSE CONTENT

1. Orientation Lectures—history of surveying, its importance and relation to engineering, work of the various governmental bureaus, etc.
2. Tapes. Various types with use. Problems and field exercises.
3. Levels and Leveling Rods. Construction, care and use. Theory of adjustments. Field exercises in differential leveling.
4. Transit. Construction, care and use. Theory of adjustments. Vernier. Field exercises in horizontal and vertical angles and in prolongation of straight line.
5. Final Lectures—limitations of the elementary course in the professional practice of surveying, ethics, discussion of licensing and registration laws.

PAUL P. RICE, *Chairman,*
D. S. TROWBRIDGE,
H. B. AIKIN.

ELEMENTARY SURVEYING FOR CIVILS FOR A SEMESTER HOUR CREDIT

1. History and purposes of surveying.
2. Distance measurement.
3. Levelling.

4. Horizontal angle measurement:
   a. Direction:
      1. Bearing.
      2. Azimuth.
   b. Angles:
      1. Interior.
      2. Deflection.

   Vertical angle measurement.
5. Methods of traversing.
6. Location of details.
7. Traverse computations.
8. Plotting.
9. Methods of land description (including U. S. Public Land System:
   a. By metes and bounds.
   b. By named subdivision.
10. Adjustment of instruments.

F. W. WELCH, *Chairman,*
A. H. HOLT,
JOHN C. PENN.

ADVANCED SURVEYING

The Committee recommends that the minimum time which should be allotted to advanced surveying is four semester credit hours. The minimum of content recommended consists of the following:

Precise measurements with precise transit, direction instrument, precise level, standardized tape and the tests of adjustments of all equipment used.

Adjustment of the observations.

An appreciation of the errors involved and their relation to the economy of the operation.

Determination of azimuth by observation on Polaris at any hour angle.

The principles of topographic surveying and mapping sufficient to enable the student to make a complete map of any area which is not large enough to involve geodesy.

The general principles necessary for the survey of engineering construction works, as setting bridge piers, etc.

Where more time is available a choice from the following list is suggested for addition:

Hydrographic surveying.
Stream gauging.
Precise traverse.

Map projections.
Two credit hours of practical astronomy.
Three credit hours of least squares adjustment of observations.
Three credit hours of photogrammetry.
Plane coördinates for geodetic purposes.

J. C. PARK, *Chairman*,
A. J. KNIGHT,
E. F. CODDINGTON,
P. H. UNDERWOOD.

A SHORT COURSE IN PHOTOGRAMMETRY

SUGGESTED THREE HOUR SEMESTER COURSE, OR EQUIVALENT

1. Terrestrial photographic surveying and mapping (Graphical problems for horizontal position and elevation).
2. Stereoscopic principles.
3. Principles of aerial photographic surveying and mapping:
   - Focal length
   - Scale
   - Flying altitude
   - Overlap
   - Air speed and time interval
   - Ground covered
   - Number of pictures

   } Flight Map Problem

   Image displacement due to topographic relief, tilt, etc.
   Parallax and its applications in determining elevations.
   Rectification (change in scale).
   Scale check problem.
4. Graphical methods of map construction:
   - Radial line method. — Problem material.
   - Template method. — Problem material.
5. Oblique aerial surveying: — Canadian Grid problem.
6. Stereoscopic mapping:
   - Stereocomparagraph.
   - Ratio projector.
   - Multiplex projector.

SUGGESTED COURSE CONTENT WHEN COURSE IS LIMITED TO FOUR LECTURES (FOR INCLUSION IN OTHER COURSES)

1. Cameras and instruments.
2. Flight map problems.

3. Stereoscopic principles.
   Application to stereocomparator and vertical aerial photographs.
4. Construction of planimetric maps. Graphical methods.

EARL CHURCH, *Chairman*,
H. O. SHARP,
G. H. HARDING.

ROUTE SURVEYING—"CURVES AND EARTHWORK"

In agreement with the motion made at the meeting on July 31, a representative committee has prepared what should be understood to represent the concensus of opinion as to the minimum content of a course offering instruction in subject matter variously named —railroad engineering, railroad surveying, route surveying, railroad and highway surveying, etc. The committee selected the name "Curves and Earthwork" and present the following outline:

Curves and Earthwork:

1. Simple curves.
2. Compound and reverse curves.
3. Transition curves.
4. Vertical curves—as determined by:
   a. Rate of change of grade.
   b. Visibility.
5. Earthwork:
   a. Cross-sectioning and slope stakes.
   b. Average end area and prismoidal formulas.
   c. Mass diagram.

It is the opinion of the committee that the fundamentals of "Curves and Earthwork" apply equally to all phases of route surveying including railroad surveying, highway surveying, canals, transmission lines, etc.

C. O. ROTH, JR., *Chairman*,
F. W. WELCH,
BROTHER A. LEO,
JOHN A. DUNLOP,
CHARLES B. STANTON.

It is significant to note in these recommendations some changes in the elementary non-civil course affecting many students, placing emphasis on such matters as the importance and relation of surveying in engineering, ethics, registration and licensing laws, the professional practice of surveying, etc. The fundamental character of these subjects to any engineering training accounts for the committee's recommendation "That an elementary course in sur-

veying be required of *all* engineering students." The suggested "minimum course content" in photogrammetry brings together the best ideas of experts in a rapidly developing field. The suggested subject matter may be given with a minimum outlay for equipment.

Other recommendations of the Conference are as follows:

1. Summer Camps.
   - *a.* Recognition of three useful elements in teaching surveying: classroom work; exercise or component type of work; and project or job type of work.
   - *b.* That the most effective and economic way of handling classroom work is during the regular academic year on the campus.
   - *c.* While it is probable that field exercises can be given more efficiently at a summer camp, it is believed that in the interest of economy of time and funds, exercises should be given on the campus where the campus permits.
   - *d.* That with due regard to the infangible values which camp life affords, the project type of work can be carried on with greater efficiency at a summer camp.
2. Licensing and Professional Matter.
   - *a.* That practical work in various fields of land surveying be placed on the same basis as engineering work as concerned with "responsible charge of work."
   - *b.* That responsible charge of engineering teaching including surveying teaching at approved institutions be considered as "responsible charge of work" in such states not already considering teaching in the above category.
   - *c.* That the theoretical portions of examinations for state license be offered applicants immediately on graduation from an approved institution in such states not already offering examinations in this manner.

The matter of the surveying profession being definitely handicapped through the lack of a medium of expression was discussed. It was quite generally agreed that the most desirable and ultimate method would be a separate publication devoted entirely to surveying and associated subjects. However, during the time this matter will be given further study by the committee, the opinion was expressed that existing periodicals ought to devote more space to surveying subjects.

The evening campfire programs were usually in charge of J. C. Park, University of Arizona. Recitations, songs by the male and female glee clubs and special talks were given: History of Camp Marston, J. S. Dodds; Peculiarities of a Glass Collector, by J. K.

Finch; History of the Brothers of the Christian Schools at Manhattan College, by Brother A. Leo; My Trip on "Old Ironsides," T. C. Adams; and The Recent Flood in the Ohio River Valley, George H. Harding. M. Y. Poling addressed the group discussing the training of engineers for the various surveying organizations of the Federal Government.

PROGRAM

July 25. Transportation from Ranier, Minnesota, to Camp Marston by boats. A 35-mile, 4-hour boat trip. The Camp, located near the International Boundary, is inaccessible excepting by boat.

July 26. Presiding, J. S. Dodds, Iowa State College. Purpose of Conference (Improvement of Surveying Instruction), Plans, Introductions. Brief 3–5 minute talks by each teacher present on the above subjects.

	Subject	*Presiding*	*Leader*	*Speakers*
July 27.	Course Content for Civils.	W. H. Rayner, Illinois	*P. H. Underwood, Cornell	W. C. Taylor, Union
July 28.	Methods of Teaching and Assigning Work. Job. Method versus Component Method.	A. H. Holt, W. P. I.	*J. B. Butler, Mo. School Mines	*J. A. Dunlop, R. P. I. *G. H. Harding, Louisville
	Course Content for Non-Civils.	Bro. A. Leo, Manhattan	*R. C. Durst, Akron	H. B. Aikin, Tennessee
July 29.	Summer Camps.	J. K. Finch, Columbia	*M. S. Douglas, Case	J. C. Penn, Armour
July 30.	Aerial Surveying Instruction.	Earl Church, Syracuse	*H. O. Sharp, R. P. I.	*G. H. Harding, Louisville
July 31.	Presentation of Committee Reports on Course Content.	Paul P. Rice, Lafayette	Various Committee Chairmen	
	Field Notes, Checking. Results, Examinations, etc.	C. O. Roth, Jr., Cooper Union	*Paul P. Rice, Lafayette	Group Discussion
Aug. 1.	Sunday devotions. Excursions.			
Aug. 2.	A.M.—Surveying Instruments. Maker and User.	F. W. Welch, St. Coll. Wash.	*D. S. Trowbridge, N. Y. U.	H. M. Dibert, M. S. Jordan
Aug. 2.	P.M.—Instruments for Student Use—Custody, Student Responsibility, Repairs, Maintenance.	C. B. Stanton, Carnegie Tech.	*E. E. Decker, Mo. School Mines	J. C. Park, Arizona
Aug. 3.	Plane Coördinates and Geodetic Control, Practical Astronomy, Cadastral Surveys.	A. J. Knight, W. P. I.	*T. C. Adams, Utah	*E. F. Coddington, Ohio M. Y. Poling, Wash., D. C.
	Public Land Surveys.		*J. S. Dodds, Iowa St. Coll.	
	Committee Reports on Course Content, etc.			
Aug. 4.	Instruction Sheets.	T. C. Adams, Utah	*C. O. Roth, Jr. Cooper	
	Relation to the Profession —The Land Surveyor— License Laws.		*Paul P. Rice, Lafayette	*G. Reed Shaw, R. P. I.
Aug. 5.	Portion of group leaves for Ranier.			
Aug. 6.	Preparation of reports.			
Aug. 7.	Conference completed.			

* Formal papers.

A great deal of initiative and courage was required on the part of the committee to conceive, initiate and carry through to a most successful conclusion an unprecedented enterprise, as was the First Surveying Teachers' Conference. Special mention must also be made of the splendid coöperation of Iowa State College in making available the ideal facilities of Camp Marston. In a manner similar to student instruction the inaccessibility of the camp held the

Conference most closely to its stated objective—Improvement of Surveying Instruction. Those in attendance lived together in one large family. In this manner an extraordinary interchange of ideas was possible as well as the making of many lasting friendships. Teachers and others in attendance are taking the suggestions, recommendations and ideas of the Conference to the sectional and other meetings of the Society and also meetings of other organizations interested in surveying. Thus the beneficial effects of the First Surveying Teachers' Conference will influence surveying practice and its teaching in engineering colleges for many years into the future.

TECHNOLOGY AND PERSONOLOGY

By R. L. SACKETT

Dean Emeritus, Pennsylvania State College

The experience of the great majority of engineers emphasizes the importance of personal qualities and the power to direct, supervise or manage the work of others.

The A.S.M.E. report of 1930 on the professional income of engineers says: "That the differences in earning power between men whose work is exclusively technical and those who combine with their technical ability the capacity to handle independent businesses or to manage men or affairs, are great—so great as to indicate the importance of most engineers seeking to develop themselves in this respect, and of engineering schools bending their curricula somewhat toward this end."

If more evidence is necessary to prove that technology should hitch itself to the star of personal qualifications, the intelligent person has only to look around him and see who are getting things done, politically, financially or industrially. Prejudice and jealousy blind the eyes of some who criticise things as they are. Making life what it ought to be depends on the development of finer and more forceful personal qualities. The young engineer needs to develop both technical knowledge and desirable attitudes and abilities.

Engineering instruction has concentrated its major effort on preparing the foundation for a technical career. That the ground work has been laid cannot be denied. It is not proposed to weaken the foundation, but to improve the super structure.

We are devoting energy to organizing pre-college guidance and especially a more adequate counsel for prospective engineering students and it is very much needed if the losses by withdrawal from college for various reasons (other than scholastic failure) are to be reduced. Such "failures" are socially and economically just as important as failure to meet standards of scholarship.

College life should emphasize the qualities needed in after life. Contacts, leadership, student and faculty relations should constitute a laboratory for the exercise of amenities, personal approach, ethics and character, and engineers and industrial executives will aid in an organized program of continuous development during college experience.

There is sufficient evidence that poor guidance or misguidance is responsible for many who withdraw as well as for some who change to another curriculum and go on to finish their undergraduate course.

Next we have freshman week as a device to help in the assimilation of the students by the college and as an aid to him in finding his way around.

There are freshmen orientation courses and problem courses designed to familiarize the new student with objectives, methods, equipment and the assembly of his mental equipment into a working device. These are all purposeful whether they reach their goals or not.

In general, little is done after admission to help the student in developing himself other than as an applied scientist. He graduates, obtains a job and then finds that he must work under, with and in charge of men. His advancement in many cases now depends upon his skill in handling human relations rather than on his deftness and accuracy in working a slip stick or his purely technical skills. Industry knows the truth of this and engineering executives know it, but not much has been done in college to emphasize the importance of personal qualities and to correct defects. The student is not properly prepared for this feature of industrial success or failure, consequently the transition to employment is not cushioned. The shock absorbers are lacking or not well adjusted. The transition to industry should be made easier and smoother.

Programs should be developed to meet this need and there is plenty of material out of which to construct the necessary sequence. The senior year at least should contain carefully prepared lectures and discussions which would treat of, and emphasize the importance of neatness, courtesy, punctuality, discretion, manners, morals and character. Industry should be interested in contributing to such efforts to pave the way for adjustment to practical work. All this is a confession. Why should the requirements for success in industry be different from those required for a degree? Why should there be need for radical readjustment to industry? The transition should be a natural step into a new environment where new experiences should contribute to continued development. The college should give not only the technical foundation and training, but also assist in obtaining the personal characteristics and outlook on life which are essential to progress. While the objectives of colleges differ from those of trade, the personal qualities desirable in one are jewels beyond price in the other—or should be. There is little use in legislating reforms in business practice if the characters of those in control are not responsive to better standards. Better

labor relations depend on the possession and use of more human qualities.

Management courses can contribute to a better understanding of the place that humanism plays in social advance.

Present engineering education needs a preface and an appendix. Pre-College Guidance is the preface. Personal developmnt through the four years should be woven into the fabric. The E.C.P.D. has encouraged self development after graduation. The process of growth should be made continuous and the engineering schools and colleges should assist in providing organized incentives, ways and means for the adjustment of the student from day to day so that his life will be a growth without shock when he transfers from school to business.

PHYSICS PLACEMENT AND ACHIEVEMENT TESTS

By C. J. LAPP

University of Iowa

Traditionally, it has been taken for granted that the function of a teacher has been to alternately teach and examine. Likewise it has been understood that teaching was a highly skilled profession demanding special aptitudes and extensive preparation. Examining, however, was something that could be done by anyone at any time for any purpose. Those of us whose educational experiences date to the World War or before, recall the good old days when an examination was ten questions for a possible score of one hundred, passing grade 70. Easy teachers and those, not properly impressed by standards, passed at 65. A few of the old guard still remain. They were born thirty years too late.

About 1920 new tests were invented and since then a bewildering series of objective tests, intelligence tests, aptitude tests, and personality tests, prepared in elaborate forms, studied and checked by statistical methods, have taken their respective places in our educational system. Each test is equipped with a proper reliability coefficient and each item has its own measured validity. These new tests, however, have no passing grade attached, and yield only percentile ranks. Is it any wonder that there is so much confusion in the thinking of teachers concerning examinations and their uses?

Whether an examination is good or bad depends entirely on the purpose of the examination. An examination might be perfect for one purpose and entirely bad if used for a purpose for which it was not intended.

Max McConn [1] finds claims in the literature that examinations:

1. Enforce some minimum degree of attainment;
2. Select for some specified purpose;
3. Provide an incentive to study;
4. Constitute a method of instruction;
5. Stimulate improvement in teaching;
6. Afford a basis for appraisal of teachers and departments;
7. Provide possible assistance to be used in accrediting of schools and colleges;
8. Furnish data for educational guidance;
9. Collect materials for research.

[1] McConn, Max, *The Educational Record*, October, 1935.

To this list the writer would add:

10. That proper objective examinations make possible the early selection of brilliant students, and provide a tool for the study of individual differences.

I interpret his conclusions as meaning that very few of the objectives could be even partly attained by the old ten-question essay examination, and that a great deal of caution must be exercised when using the best made objective examination for some of the purposes outlined above.

For purposes of discussion may we state that a good examination should have the following characteristics:

1. It should cover the prescribed field by an adequate sampling of the material. Posey [2] in an article, "Luck and Examination," has statistically discussed the effect of inadequate sampling. He assumes three thousand hypothetical students, one-third each of whom have mastered respectively 50 per cent, 70 per cent and 90 per cent of the material in a given course. Posey's curves shown in Fig. 1, over-emphasize the point. However, they bear eloquent testimony to the injustices that are likely to come from inadequate sampling. Those interested in examinations should study his original paper.

2. A good examination must, each time it is given, arrange students in the order of their general achievement. This property is called "validity" and is much more difficult to get than would be supposed. For an item to be valid, the students who succeed on it should be superior in general achievement to those who fail. The degree to which two equivalent forms of the same examinations arrange students in the same order is called the "reliability" of the examination. A good examination should be both valid and reliable.

3. A good examination minimizes successful "guessing" by a bright student who has only a superficial knowledge of the subject. This is one of the dangers to which objective items are subject, particularly when these items are formulated by inexperienced test makers.

4. A good examination should permit the student to use his time and energy efficiently for the purpose of demonstrating his mastery of the subject matter. Needless searching through words and sentences, needless computing with decimals and odd figures when a simple computation based on a carefully designed item would do better, needless writing of material over which the mind works ten times as rapidly as the fingers, unjustifiably waste both the time and energy of the student. In writing a good examina-

[2] Posey, JOURNAL OF ENGIN. EDUC., Vol. 23, December, 1932.

tion the fingers should be able to keep with the mind, and the student's energy should be absorbed by his brain instead of his muscles.

5. The good examination should give opportunity for students

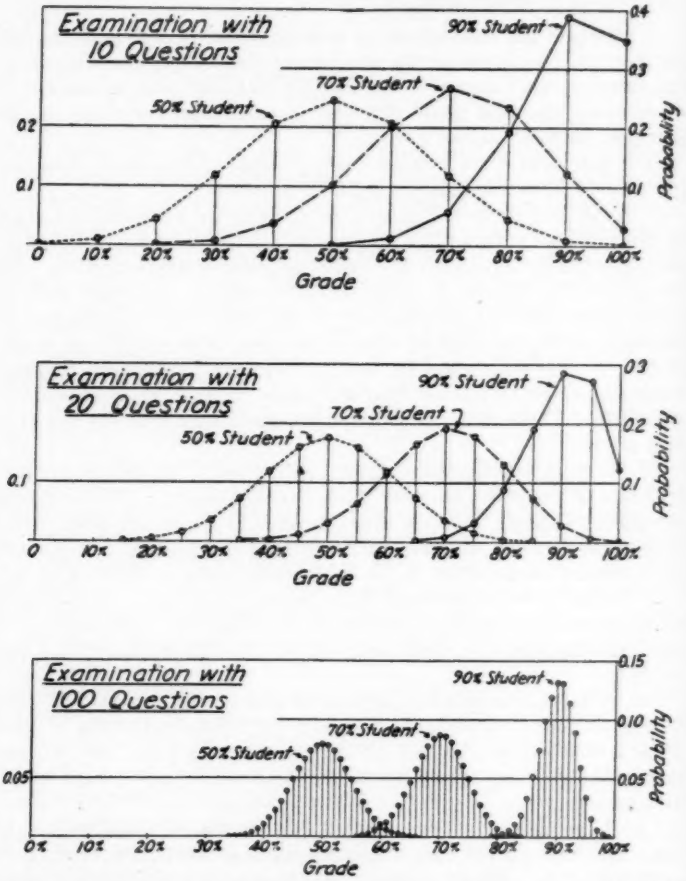


FIG. 1. Charts showing probabilities that a student whose knowledge of a subject is 50 per cent, 70 per cent or 90 per cent will get various grades on 10, 20, or 100-question examinations.

at all levels of ability to display their achievement. The examination must be of such length and difficulty that the best student will have a chance to show he is the best. The worst student must have

a fair chance to show that he is the worst. Most essay examinations are very weak at this point.

6. A good examination should be functional. That is, it should measure the student's ability to make use of the information he has obtained from the course. Many students can give back from memory in exact book language many laws, principles and facts, but the same student might not even recognize the type of situation if stated in new language or if used in a new situation.

7. It should be possible to duplicate a good examination from year to year from new material. Practically all of the examination objectives referred to above demand this premise. Yet it is not easy to fulfill.[3]

8. A good examination should be set by some individual outside the course. This is a controversial premise. A teacher may argue that his students are accustomed to his approach, that he has emphasized certain matters, has included special topics. Fair enough, yet Newton's Laws, Archimedes principle, uniformly accelerated linear and rotary motion are the same in any language and any text book, and if my students can "deliver the goods" they should be able to answer the questions approved by a committee of experts as well and with more satisfaction than answering my own.

9. A good examination should arrange students in the same order regardless of which one of a group of recognized teachers grades it. The examination will not be injured if it is of such a nature it can be graded quickly. To discuss these premises would be to repeat platitudes.

10. Last and probably most controversial, a good examination should measure in a given area, retention by memory, power to discriminate and ability to reason in ratios determined by the objectives of that particular examination.

At the present time, to my knowledge, there are only two agencies handling Physics Examinations of College grade. The Bureau of Research and Service, Extension Division, University of Iowa, has sold many thousands each of two series of examinations A and B, covering Liberal Arts College Physics. Each series contains eight examinations. The Testing Committee of the American Association of Physics Teachers had prepared five sets of matched pairs over the individual topics, Mechanics, Heat, Sound, Electricity and Magnetism, sixty examinations in all. These tests are handled by the Coöperative Test Service of the American Council of Education, New York City.

The most serious charges that have been brought against them are as follows:

[3] Palmer, Frederic, "The Helpfulness of Objective Tests in Physics," *J. Ch. Ed.*, Mar., 1937, p. 109.

1. They test factual knowledge only and do not measure the ability of a student to think.

2. Students would be arranged in different order of achievement if they were given more time to write the examination.

3. Students are deprived of self-expression.

4. They tend to standardize College Physics courses.

To think, to reason, to meditate, to make connections, and see relationships between objects, events, and acts, to make abstractions and to draw conclusions—surely these are the most precious jewels developed by education, if they are developed. A critical appraisal of any of the examinations made by the Testing Committee of the American Association of Physics Teachers will disclose that the items are divided almost evenly between those which require chiefly factual information and those which require chiefly ability to reason. Consider the following items:

"The weight of an object on the moon is one-sixth its weight on the earth. Therefore a body moving with a given velocity on the moon would have (1) 1/6 the kinetic energy it would have on the earth, (2) 6 times the kinetic energy it would have on the earth, (3) 1/36 the kinetic energy it would have on earth, (4) 36 times the kinetic energy it would have on the earth, (5) the same kinetic energy as on the earth."

This question has a difficulty rating of 15 and a validity index of 9; which means it was answered correctly by fifteen per cent of the students and discriminated almost perfectly between good and poor students.

"The pitch of a pipe in a church organ on a hot day as compared with its pitch on a cold day is likely to be (1) unchanged, (2) somewhat higher for a closed pipe, (3) somewhat lower for a closed pipe, (4) somewhat lower for an open pipe, (5) unchanged for an open pipe only."

The difficulty rating was 45 and the validity index 7, an easier item than the first but very discriminating.

All will agree that these items demand ability to think. They are fair samples of the test items.

Concerning charge number two, many experiments[4] have been conducted around this point. These experiments all point in the same direction, that with very few exceptions students arrange

[4] Lapp, C. J., *American Physics Teacher*, "Time Item Ratio in College Physics Tests," December, 1934, Vol. 2, p. 177. Knipfer, The Influence of Time of Administration Upon the Reliability and Validity of an Achievement Test in Mathematics; Master's Thesis, University of Iowa, 1936. McDonough, An Evaluation of a Technique for Determining Optimum Time of Administration of a Test; Master's Thesis, University of Iowa, 1931.

themselves in approximately the same order when given double the time. Any teacher who doubts these findings should try it on a large class.

The answer to charge number three, that students are denied self-expression, is to obvious to merit a discussion.

Some have thought the charge of standardization to be a serious one. The Committee uses only material recognized as being the central core of a first-course in College Physics. No controversial material is included and no passing grade is suggested for any test. Because only that which is recognized as being the most fundamental physics is included in these examinations, the Committee urges all who use these tests to use supplementary material of their own to cover topics given special emphasis.

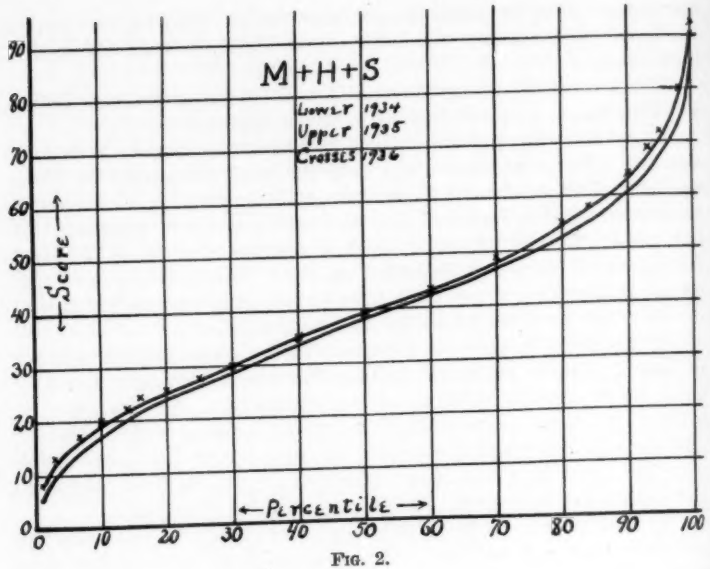
If including in the tests Newton's Laws of Motion, the moment of inertia, simple harmonic motion, Doppler's Principle and kindred topics, brings a charge of standardization, the Committee is guilty. If there are institutions giving courses called College Physics in which these topics were not included and if in any small way the Committee has been influential in having them included, the Committee is grateful for the opportunity of service.

The statement has been made that these tests were published in matched pairs. A matched pair can be made as follows: Two complete forms are made for one subject, say mechanics, having a pre-determined number of factual and problem type items in each of the subdivisions. These tests are then criticized by each member of the Committee after which a sub-committee rebuilds the tests with the aid of the critical comments. The tests are given to approximately 5,000 students after which the items are carefully analyzed for difficulty and each response studied for validity. Bad responses and bad items are replaced and the items over any subdivision are arranged in matched pairs for difficulty. The two forms so made are finally studied as a whole to insure the proper distribution of item difficulty. This technique has not only produced matched pairs but the pairs from year to year have been very nearly identical in difficulty.

Figure 2 shows the total semester test grades as ordinates against the percentiles as abscissas. The upper curve is for 1934 and the lower for 1935. These curves are practically parallel and almost identical showing how accurately the Committee's test building technique operates. No attempt was made to match these tests.

Figure 3 [5] is a bar chart representing the achievement of 15 institutions including engineering schools, universities, four-year

[5] Figure 3 taken from 1935 Report of the Committee on Testing, American Association of Physics Teachers.


M+H+S
Lower 1934
Upper 1935
Crosses 1936
Score
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20
30
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50
60
70
80
90
100

FIG. 2.

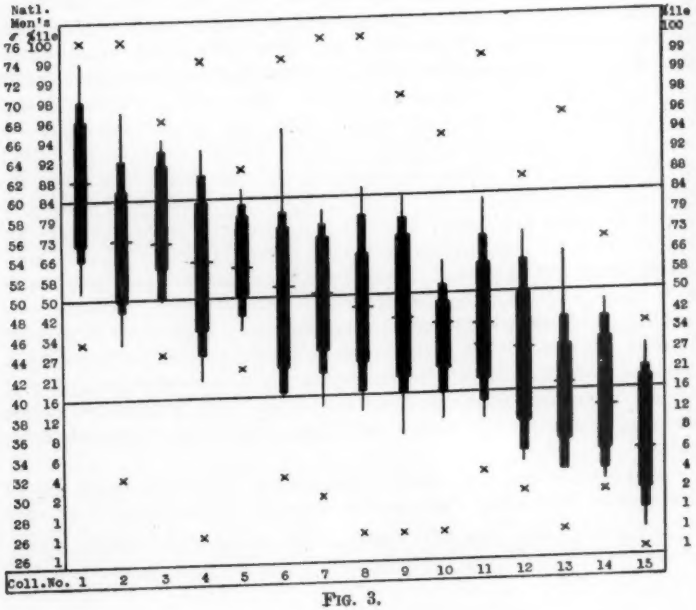
Natl. Men's %ile
Coll. No. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

FIG. 3.

colleges, junior colleges and teachers colleges. The middle horizontal line shows the national median and the other two are at the 16th and 84th percentiles of the national distribution. Each of the bars represents an individual college. The wide portion of each bar represents the range of scores of the middle half in each college. The narrow parts extend to the 16th and 84th percentile in each college, *i.e.*, one standard deviation above and one below the mean. The lines at the ends extend down to the 10th percentile and up to the 90th percentile. The crosses below the bars represent the lowest scores and those above represent the highest scores in the several colleges (the range). The short cross line at the middle of each bar represents the median score of the college.

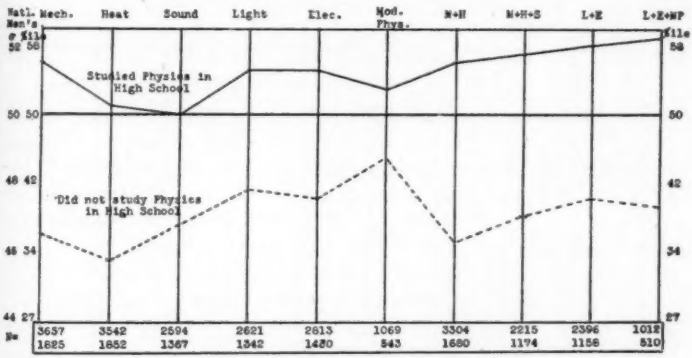

FIG. 4.

There are many interesting things on this chart. There is a tremendous variation in achievement from school to school. The upper three schools have almost nothing in common with the lower three. In college 15, one-half of the students are in the lowest six per cent of the national distribution for men, while in college 1, 90 per cent are above.

There is an even greater variation within schools. Every college save three has prize dumb-bells, while half of the schools have at least one in the 98th percentile or above.

For many years teachers of College Physics have argued over the merits of high school physics. Many have taken the extreme position that the achievement in College Physics is adversely effected or at least independent of whether or not the student has had physics in high school.

Figure 4 [5] presents a violent contrast to the confusion in the thinking among college teachers on this subject. Averages from

over 5,000 students are shown who studied or did not study physics in high school. The data are graphed in terms of the national percentile scale for men altered to conform with a sigma scale to make vertical distance roughly comparable. This chart rather settles the argument. However, it does not tell us the influences acting to produce the surprising result.

Figure 5 [5] representing data on more than 5,000 students gives us a severe jolt. It shows the averages of students who receive three, four and five hours of college credit per semester for college physics. Quite obviously the three-hour courses are slighting Sound, Light and Electricity. It is equally obvious that either the five-hour students are not getting their money's worth, or these tests do not measure their possible achievement. If I were an

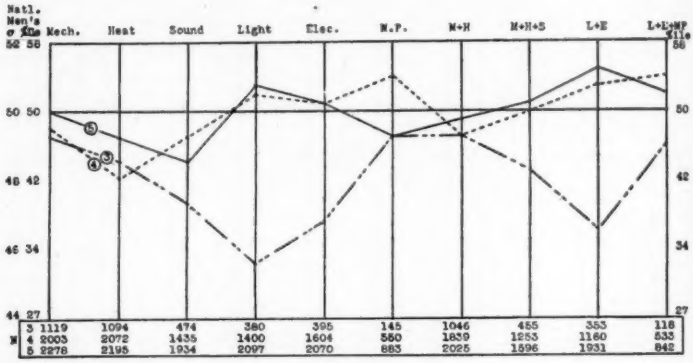

FIG. 5.

administrative officer in a college, and if I were paying for a five-hour course in college physics, I would look into the situation to see if I were getting my money's worth.

The whole field of aptitude testing in College Physics is quite undeveloped. So far as I know the University of Iowa is the only school where such work has been done. Stoddard and Lapp [6] in

[6] Bear, Robert M., "The Predictive Value of the Iowa Physics Placement Test." *J. Appl. Psychol.*, 1927, Vol. 11, 381–384. Blue, Emery Lee, Physics Aptitude of High School Seniors. State University of Iowa, Unpublished Master's Thesis, 1927, pp. 66. Hammond, H. P., and Stoddard, George Dinsmore, "A Study of Placement Examinations." *Univ. Iowa Stud., Stud. in Educ.*, 1928, Vol. 4, No. 7, pp. 59. Langlie, T. A., "Analysis of the Iowa Placement Tests." *J. Appl. Psychol.*, 1926, Vol. 10, 303–314. Langlie, T. A., "The Iowa Placement Examinations at the University of Minnesota." *Society for Promotion of Engin. Educ. Proc.*, 1927, Vol. 34, 842–860. Langlie, T. A., "A Comparison of 'Aptitude' and 'Training' Tests for Prog-

building a College Physics Aptitude Examination assumed that if a reliable measure could be obtained on four separate abilities these measures might be statistically compounded to give a prediction for success in college physics.

Part 1. The ability to handle the elementary skills in mathematics such as decimals, percentage, proportion, reciprocals, roots, substitution, linear equations, etc.

Part 2. Reading comprehension as measured by the ability to gain information from a well-written paragraph on some physical phenomena, and to resist unwarranted generalizations.

Part 3. The ability to do plain abstract logic. "A divided by B equals D divided by C. Therefore, AC = BD."

Part 4. Active interest in physics as measured by the stock of common useable information. "On entering a river from the ocean a ship sinks deeper into the water." "All gases have weight." "Efficiency equals output divided by input." "A transformer cannot be used on D.C."

These tests have high reliability, well-established norms and are available in two forms.

This Engineering Society encouraged the building of these tests twelve years ago. Since then they have had wide use and a considerable literature has been built up around them.[7]

For the past two years the writer has used large pre-medic classes to study predictive indices. The 1934–35 class was given: (1) a physics pre-test, of the same type sponsored by The American Association of Physics Teachers Testing Committee, except twice as long; (2) a physics training test of the regular Iowa series; (3) a special test over the mathematical skills needed in college physics. Mathematics aptitude and composite intelligence scores were available from the freshmen records.

The summary Table below from Lillard,[8] who worked up these data, shows that of the students receiving A, 77 per cent were found in the first quartile as measured by the Physics Pre-test, 100 per cent were found in the upper quartile as measured by the

nosis." *J. Educ. Psychol.*, 1928, Vol. 19, 658–665. Mann, Clair V., "An Evaluation of Placement Examinations." J. ENGIN. EDUC., 1928–1929, Vol. 19, 288–300. Stoddard, George D., "Iowa Placement Examinations." J. ENGIN. EDUC., 1925–1926, Vol. 16, 158–163. Stoddard, George D., "Iowa Placement Examinations." *Univ. Iowa Stud., Stud. in Educ.*, 1925, Vol. 3, No. 2, pp. 103. Wilcox, E. R., "Placement Tests as a Means of Predicting Failures in First-year Work in Engineering at the University of Washington." J. ENGIN. EDUC., 1929–1930, Vol. 20, 791–794.

[7] Feder, Dr. Daniel D., The Use of Iowa Placement Examinations in Physics Instruction, Bureau of Educational Research and Service, University of Iowa.

[8] Lillard, Unpublished Master's Thesis, August, 1936.

Mathematics Aptitude, Composite and Physics Training Tests, and 97 per cent were in the upper quartile as measured by the Mathematics Skills Test. *In the group found in common from the upper quartiles of these five tests are the very best students. They can be located before the first physics lesson has been assigned.* These are the students who will achieve in physics. It can and should be of great importance to locate them.

SUMMARY OF PREDICTIVE ABILITIES

	First Sem. Final Grade			
	A	B	C	D and Fd
Physics Pre-Test	77	82	51	74
Math. Aptitude	100	78	60	84
Composite	100	83	63	85
Phys. Training	100	72	57	96
Math. Skills	97	74	53	87

A's in Q_1 of Predictive Measure
B's in $Q_1 + Q_2$ of Predictive Measure
C's in $Q_2 + Q_3$ of Predictive Measure
D's and Fd's $Q_3 + Q_4$ of Predictive Measure

SUMMARY

1. Since the testing program in physics is the most elaborate measurement project in any given subject-matter field, physicists have an unusual opportunity, if not a challenge, to influence local administrations. It is the opinion of many impartial observers that knowledge about students—their achievement, their interests—is a crying need. Physicists can do much to bring this point of view home to college executives and thus contribute to better selection and classification of students and to the shaping of curricula in keeping with the powers and interests of all classes of matriculants.

2. Achievement measuring instruments have been developed which make possible research in the teaching of college physics. The intelligent use of these tools should produce new and important findings.

3. Great variability is found between achievement in physics from college to college.

4. Even greater variability is found in the individual differences between students in the same class.

5. Achievement growth in college physics is as variable from college to college as is total achievement. During the study of

mechanics one college class advanced its mean from the 8th to the 11th percentile, measured from the bottom, while another class advanced its mean from the 36th to the 90th.

6. Many of the very ablest students in the nation are found in obscure colleges.

7. Pre-tests show these students of exceptional ability have an A rating before they study the course.

8. The average of the four- and five-hour courses in the country appear to be achieving about comparable results as measured by the nation-wide physics testing program.

9. Predictive measures have been developed which permit a high degree of accuracy in determining the student of exceptional ability.

10. A nation-wide sample, students having high school physics have markedly higher achievement than those not having it.

Which of these is most important? The writer is not sure. Being able to locate the exceptional student whether he be in Podunk or Purdue, and to locate him very early in the game so that proper guidance may develop him at the level of his ability, to the end that he may take his place among the creative minds so needed by our civilization. This is, in my opinion, the most important.

ENGINEERING ECONOMY PAGE

Engineering economy specifically relates to the cost aspects of engineering in all phases of the practice of the profession: planning, construction, production, distribution and utilization. Engineering economy in education relates to all the cost aspects of engineering in practice and in addition serves as a threshold through which the engineering student may be directed to an interest in and future participation in the administration and management of industry and civic affairs.

EDMUND D. AYRES, University of Wisconsin, *Editor*

SCOPE OF THE TERM "ENGINEERING ECONOMY"

Because of the very limited space available and the many features which should be presented on this page during the coming year, we feel that delineating the scope of the term "Engineering Economy" must not be permitted to absorb too much of this valuable space. To carry on the search for the best concise statement of this scope, each month this page will print in italics below the title of the page, one of the statements sent in to the editor during the month. After a reasonable period all statements sent in, whether printed or not, will be submitted to the Committee on Engineering Economy for their choice of a statement to be always carried at the head of the Engineering Economy Page as a simple reminder to all of the boundaries of our bailiwick.

The "mast-head" carried this time is a statement proposed by your editor. This leads directly to the following lists delineating the subjects within our jurisdiction in terms of the items given in our September page.

Complete Jurisdiction

(1) Engineering costs.
(3) Business administration for engineers.
(5) Public service matters relating to engineering work.
(6) Social studies and humanities relating directly to the judgment factors and philosophy of engineering practice.

Partial Jurisdiction

(2) Shop and factory management.
(4) Personnel and placement matters.
(5) Public service matters relating to matters not strictly involving engineering work.
(6) Social studies and humanities as cultural courses for engineers.

Without attempting an exhaustive list of subjects suggested by the four general topics considered under our complete jurisdiction, the following list of topics taken at random is intended to make these general topics more specific: Teaching of cost aspects of engineering in school, Production costs, Costs of distribution, Overhead costs, burdens or loadings, Cost accounting including standard costs, Cost indices, Statistical methods, Construction costs, Economic selection ("Will it pay?" problem), Economic replacement ("Will it pay?" problem), Depreciation in engineering studies, Increment costs, Sunk costs, Immediate economy in engineering studies, Ultimate economy in engineering studies, Design for increasing demand, Judgment factors or irreducible data, Time value of money, Economic lot sizes, Standardization, Economic choice of tools and machinery for construction, Immediate vs. ultimate economy, Accounting for engineers, Organization of business units for engineering enterprise, Organization for operation of engineering enterprise, Financing engineering enterprise, Analysis of financial statements for engineers, Budgetary control for engineers, Promotion of engineering enterprise, Industrial merchandizing, Industrial marketing, Interrelation of economic factors in production and distribution in engineering enterprise, Valuation theory and practice, Engineering studies of public works, Management of construction projects, Contracts and specifications, Engineering report writing, Public utility rates, Influence of economic and social factors upon engineering results, Interrelation of costs and prices, Technological unemployment, Economics of industrial management, Balancing of economic forces, Analytical and mathematical treatment of economic and social studies relating to engineering enterprise or practice, Patents, Human relations in industry (Cost aspects and relations to engineering enterprise), Engineering economy as an educational threshold.

Many of the items in the above list cover debatable ground but we believe that certain aspects of all these topics are fully within our jurisdiction. If you do not agree with the ideas given above, which your editor has attempted to cull from interviews and correspondence about these matters—write in now—submit a masthead statement.

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FRED W. SLANTZ, EDITOR

Editor's Note:

On the matter of "taking over" there is little to be said other than that the editorial WE covers a multitude of sins of omission and commission. The folds of the mantle are ample, however, coming down from the broad shoulders of our predecessors as described so aptly in the letter from our genial Chairman of the Division of Engineering Drawing and Descriptive Geometry, Professor John M. Russ: "This is to confirm the rumor to the effect that you were unanimously elected Editor of the T-Square Page for the year 1937–38. The precedent established by Higbee, and so ably carried on by Heacock, will I hope, disconcert your self-confidence. The 'Old Guard' of the Division are, as you know, the salt of the earth. Now they are relinquishing some of the responsibilities to our younger shoulders, I hope you join me in enjoying the experience to the same degree."

FRED W. SLANTZ, *Editor,*
Lafayette College.

REPORT OF THE JUDGING COMMITTEE, NATIONAL DRAWING COMPETITION, 1936–1937

DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY, S. P. E. E.

Cambridge, Mass., June 30, 1937

Class	*No. of Entries*	*Award*	*Institution*	*Instructor*	*Student*
AP	22	1	Union College	R. A. Hall	Harold D. Wells Jr.
		2	Rensselaer P. I.	H. P. Howe	John N. Emory Jr.
AT	18	1	Michigan State	J. E. Robertson	Lester Barnes
		2	Univ. of Detroit	J. Gerardi	Stanley Siggs
AI	25	1	Univ. of Detroit	J. Gerardi	Stanley Siggs
		2	Union College	R. A. Hall	L. J. Koslevear
BP	26	1	Michigan State	E. H. Stewart	C. W. Hertel
		2	Univ. of Detroit	J. Gerardi	Leo Skowron
BT	22	1	Univ. of Detroit	J. Gerardi	Henry L. Gieryn
		2	Memorial Univ. College, St. John's N. F.	S. J. Hayes	W. C. Brown
BI	20	1	Rensselaer P. I.	J. S. Rising	Hamlin Leonard
		2	Univ. of Illinois	R. K. Vierck	A. R. Mueller
C	21	1	San Mateo J. C.	F. Paulsen	David Neptune
		2	Univ. of Nebraska	E. J. Marmo	C. R. Eberline
D	14	1	Princeton Univ.	F. A. Heacock	Carl Beck
		2	Rensselaer P. I.	J. S. Rising	Paul D. Frost
E	17	1	Univ. of Nebraska	T. T. Aakhus	Paul Harm
		2	Rensselaer P. I.	G. M. Phelps	John Demsey

There were 31 institutions entered, of which 9 placed as compared to 10 placing last year. Only 2 institutions that placed last year repeated in 1937. These were Univ. of Detroit and Univ. of Illinois. Of the 10 winners last year, 8 entered again this year.

Judging Committee,
H. C. T. EGGERS, Minnesota,
H. C. HESSE, Virginia,
A. W. LEIGHTON, Tufts, Chairman.

ENGLISH NOTES

DEVOTED TO THE INTERESTS OF TEACHERS
OF ENGLISH IN ENGINEERING SCHOOLS

J. L. VAUGHAN, *Editor*

REFLECTIONS ON "ENGINEERING ENGLISH"

There is no such thing as "engineering English." A man who can write good, clear, cogent American English can write anything. The only trick to "engineering English" is the vocabulary. If a man can't pick that up and handle it competently, he can't write at all. Any basic instruction in exposition and description *in any field* will do equally well for the engineering field. There should be no mystery about it, nor any bother about technicalities. If a man can write a good letter, he can write a good business letter. The prerequisite is that he must be a good man. If he is not a good man, there is no use bothering with him. *Throw him out.* If he is a good man, nine-tenths of what he must know he will pick up by himself. That is why any able man will find courses in composition or even literature *per se* so deadly dull, so infernally useless.

What I mean is that detailed examination of the technique of business letters or engineering reports seems to me pretty unimportant for all but the dullest men who are able to learn only by rote. The average competent man ought to be able to pick up method regardless of the material. His ability to write an exposition on a historical or philosophical subject ought to serve him in equally good stead with an engineering subject. There is no special mystery to it. The student trained only in the minutiae or technicalities of business reports is restricted to that field. Training in English must be general training in principles, not the details of any specialty.

No spring can rise higher than its source. The student must read in order to get ideas. If he hasn't any ideas, he can't write, no matter how much of the technicalities he has learned. As we say at Tech, that kind of student is likely to turn out to be a surveyor or draughtsman or routine chemical analyst or run-of-the-mine salesman. A ten-dollar-a-day-man. We are not particularly interested in educating that kind of man at M.I.T. Perhaps he can be trained, but he can't be educated. Let him go to one of the big state automats and prepare himself for the level he will inevitably reach.

ROBERT E. ROGERS,
Professor of English,
Mass. Institute of Technology.

SECTIONS AND BRANCHES

The **Allegheny Section** held its third annual meeting at West Virginia University, Morgantown, W. Va., October 22–23, 1937. The following program was presented:

Friday, Dean R. P. Davis, West Virginia University, presiding.

Address of Welcome: C. S. Boucher, President, West Virginia University.

Response: L. C. McCandliss, University of Pittsburgh.

The Primary Obligation in Engineering Education, C. C. Williams, President, Lehigh University.

Developing Executives, E. B. Roberts, Westinghouse Electric & Mfg. Co.

Discussion, led by H. P. Hammond, Pennsylvania State College, W. N. Jones, Carnegie Institute of Technology, E. A. Holbrook, University of Pittsburgh.

Business Meeting.

Annual Dinner followed by a talk—

The Grafton Dam and Flood Control in the Pittsburgh District, Col. W. E. R. Covell, Pittsburgh, Pa.

Second General Meeting, Saturday, Vice President McCandliss, presiding.

Theme: Service Courses in Engineering.

Importance of Coördinating the Science Courses in Engineering, R. E. Doherty, President, Carnegie Institute of Technology.

Draughting: An Essential Subject in an Engineering Course, H. D. James, Consulting Engineer, Pittsburgh.

Selling Accounting to Engineers, C. L. Van Sickle, University of Pittsburgh.

Economics and Engineering Economy, C. E. Bullinger, Pennsylvania State College.

The Value of Physical Chemistry to Engineering Students, R. A. Gardner, Bucknell University.

Discussion, led by Professors Guild, Carnegie Institute of Technology and Tobias of Pennsylvania State College.

Trip to Grafton Dam in the afternoon.

COLLEGE NOTES

Carnegie Institute of Technology.—A coöperative educational enterprise which will link the Westinghouse Electric and Manufacturing Company and the Carnegie Institute of Technology in a new program of undergraduate engineering training was announced October 13 by President Robert E. Doherty of Carnegie Tech. To make this project possible, and in recognition of other educational services which are being rendered by Carnegie Tech, especially in the Evening School, the Westinghouse Company has appropriated $200,000 to the Carnegie Institute of Technology.

The new coöperative program, which will go into effect at the beginning of the next school year, will make it possible for a number of students with superior qualifications to take the usual technical courses for a degree at Tech and, during the same period, to get extensive shop and engineering experience and training in th Westinghouse plant. Of the group of students who will be selected to follow the coöperative course, a number, perhaps ten each year, will receive George Westinghouse Scholarships. A George Westinghouse Professorship of Engineering will also be established, and one of the duties of the holder of this position will be the supervision of the coöperative program.

The coöperative program which has been formulated by E. B. Roberts of Westinghouse and President Doherty marks an innovation in engineering at Carnegie Tech, as well as a closer relationship between industry and education in Pittsburgh. The program of study will cover five years, of which four academic years will be spent at Carnegie. The summer months and two college semesters, one in the third and one in the fourth year, will be spent at the Westinghouse plant. Of the students selected for the course, those designated as Westinghouse scholars will receive an income of $50 per month during the five-year training period from the company.

Students will pursue courses not only in electrical engineering, but in the other engineering branches as well. Applications for admission to the coöperative program will be received after January 1, 1938. In due course a formal announcement regarding the details of the program will be made.

The appointment of two new members to the Board of Trustees of **Case School of Applied Science** and the promotion of four members of the faculty was announced today by W. E. Wickenden, President of the College. The new trustees are Philip E. Bliss, President of the Warner and Swasey Company, and Alexander C.

Brown, First Vice-President of the Cleveland Cliffs Iron Company, and former president of the Cleveland Chamber of Commerce. Both men have been active in the civic life of Cleveland and are nationally known figures in the engineering world. Mr. Brown is a graduate of Yale University in the Class of 1907, a Member of the American Iron and Steel Institute, the American Society of Mechanical Engineers, and a member of the board of directors of a number of industrial corporations.

Mr. Bliss attended Ohio Wesleyan University and has been President of the Warner and Swasey Company since 1928. He is a former president of the National Machine Tool Builders' Association, a Member of the American Society of Mechanical Engineers and the National Industrial Conference Board. His appointment to the Case Board of Trustees fills the vacancy left by the death of Mr. Ambrose Swasey last June.

The four promotions announced by the President are as follows: Kenneth H. Donaldson from Associate Professor of Mining Engineering to the rank of full Professor; Anatole C. Seletzky from Assistant Professor of Electrical Engineering to Associate Professor; Herbert R. Young from Assistant Professor of English to Associate Professor; and Eric A. Arnold from Assistant Professor of Analytical Chemistry to Associate Professor.

The Citadel.—The Civil Engineering Department has occupied the recently completed Engineering Hall. This building was designed with specific reference to the needs of the Department and contains three laboratories—concrete, hydraulics, and general materials; four drafting rooms, three class rooms, and the necessary offices and store rooms. A 400,000–200,000 lb. Southwark-Emery machine with clearance for testing ten foot specimens, has been installed in the materials laboratory. Funds have been allotted for equipping an undergraduate hydraulics laboratory. The asphalt and soils mechanics laboratory remains in the old location.

C. S. Ades, assistant professor of civil engineering, has resigned and his place is filled by H. R. Nettles, who has served as instructor in civil engineering at Lehigh and Dartmouth. Mr. Nettles will teach steel design and direct laboratory work in structural materials.

The staff now consists of L. S. Le Tellier, John Anderson, H. G. Haynes, W. L. Daniel, Jr., and H. R. Nettles. The enrollment this year is: Sophomores 41, Juniors 31, Seniors 24. Freshmen do not make final selection of their major work until the completion of the first year.

University of Illinois.—A number of changes and promotions occurred in the staff personnel of the Engineering College of the University of Illinois this year, some of which are as follows:

Hardy Cross, Professor of Structural Engineering, resigned to accept a position as Chairman of the Department of Civil Engineering at Yale University. Cloyde M. Smith, Research Assistant Professor of Mining Engineering, resigned to become editor of a new coal journal called "Mechanization," The Magazine of Modern Coal, with offices in Washington, D. C. Alfred E. Badger, Research Associate in Ceramic Engineering, left on September 15 for three-months' period of absence to do certain research work in glass technology at the Kaiser Wilhelm Institut für Silikatsforschung in Berlin, Germany.

J. H. Bartlett, Jr., Associate Professor of Theoretical Physics, returned from a year's sabbatical leave of absence spent at the Institute for Advanced Study at Princeton University. G. M. Almy, Assistant Professor of Physics, returned from a sabbatical leave which he spent during the second semester of last year at Johns Hopkins University. Albert Jorgensen, Associate in General Engineering Drawing, is on leave this year to exchange positions with J. N. Arnold, Assistant Professor of Practical Mechanics at Purdue University. Professor Arnold is offering a special course in Graphical Calculations in addition to his regular courses in drawing.

Charles T. Knipp, Professor of Experimental Electricity, became Professor Emeritus at the beginning of this school year. Professor Knipp came to the University in 1903 as Assistant Professor of Physics and has been here continuously since that time. No one has yet been appointed to succeed him. Jamison Vawter was promoted from Associate Professor of Civil Engineering to Professor of Civil Engineering, and Carroll C. Wiley was promoted from Associate Professor of Highway Engineering to Professor of Civil Engineering.

The extension teaching courses offering graduate work in Civil Engineering, begun last year in Chicago by Professor Hardy Cross, are being continued this year by Professor Thomas C. Shedd. These courses are being given in coöperation with the Western Society of Engineers.

On October 1, the enrollment for the Engineering College was 89 graduate students and 1727 undergraduates, as compared with 99 graduates and 1476 undergraduates at the same time last year.

University of Maine.—The following members of the staff were promoted from associate professors to professors: Bertrand F. Brann, Professor of Chemistry; Harold W. Leavitt, Professor of

Highway Engineering; Harry D. Watson, Professor of Mechanical Engineering.

Assistant Professor Earl M. Dunham, of the Engineering Drafting department, resigned to accept a business position. He is replaced by Mr. Matthew McNeary, a graduate of Pennsylvania State College. Cecil C. Tyrrell, Instructor in Mechanical Engineering, resigned to accept a position as Assistant Professor of Mechanical Engineering at Pratt Institute. He is succeeded by Mr. Howard P. Lekberg, a graduate of Worcester Polytechnic Institute. Philip N. Seal, a graduate of Worcester Polytechnic Institute, has been appointed Instructor in Electrical Engineering.

On leave of absence for 1937–38 are Edgar J. Bogan, Instructor in Chemistry, and Warren H. Bliss, Instructor in Electrical Engineering. Mr. Bogan is to continue advanced studies at Ohio State University. Mr. Bliss is connected with the Radio Corporation of America in New York City. Associate Professor Lyle C. Jenness, who was on leave of absence last year as a candidate for a doctor's degree in Chemical Engineering at Massachusetts Institute of Technology, returned to the University this fall.

Wilbur E. Bradt, head of the department of Chemistry and Chemical Engineering, has been appointed chairman of a faculty committee to formulate a patent policy for the University.

Paul Cloke, Dean of the College of Technology, was re-elected President of the Maine Chapter of the American Planning and Civic Association at the annual meeting in July.

The engineering faculty is considering the advisability of changing the designation of degrees from B.S. in Civil Engineering, etc., to B.C.E., etc., and probably would be glad to inaugurate this change if other New England colleges were in accord.

University of Maryland.—Acting Dean S. S. Steinberg announces the following appointments in the College of Engineering effective September 16, 1937:

J. B. Huckert, appointed Associate Professor of Mechanical Engineering. Formerly on the teaching staff of the University of South Dakota and the University of Louisville, and recently with the Bausch and Lomb Optical Co. Dr. Huckert received the degree of B.S. in M.E. in 1920 and B.S. in E.E. in 1923 from the University of South Dakota; the degree of M.S. from the University of Illinois in 1925 and Ph.D. from Cornell in 1934.

E. J. Lindahl, appointed Instructor in Mechanical Engineering. Formerly Instructor in Mechanical Engineering at the Catholic University, and recently with the Hydraulics Laboratory of the National Bureau of Standards. Mr. Lindahl received the degree of

B.S. in 1932 and the degree of M.S. in 1933 from the University of Wyoming.

E. C. Ingalls, appointed instructor in Civil Engineering. Formerly draftsman with the Pittsburgh-Des Moines Steel Co. Dr. Ingalls received the degree of C. E. in 1934 and the degree of Doctor of Civil Engineering from the Rensselaer Polytechnic Institute in 1937.

John Lowe III, appointed Instructor in Civil Engineering, Mr. Lowe received the degree of B.S. in C.E. from the College of the City of New York in 1936 and the degree of S.M. from Massachusetts Institute of Technology in 1937.

Massachusetts Institute of Technology.—In modern structures in the civil and mechanical fields in which vibratory and reversed loading are encountered, certain troublesome failures have occurred after a period of service, despite the usual design precautions, and contradictory to static laboratory tests. Early explanations attributed the difficulty to a "crystallization" of the metal, on account of the appearance of the fracture, and even after thirty years of more enlightened investigation it seems that "crystallization" is still strong in the mind of the mechanic.

Even before the fundamental mechanism of the fatigue failure was understood, it was recognized that laboratory tests involving vibratory loading were necessary to simulate service conditions and to furnish data for design. On this basis designers have called for, and testing engineers have furnished a large amount of statistical data relating the stress imposed on a given material to the number of vibrations, or cycles of reversal of loading, which it will withstand without fracture.

The Testing Materials Research Laboratory of the Department of Mechanical Engineering has taken up the work carried on by a few investigators in the last fifteen years, and has constructed, under the direction of Robert W. Vose, a special machine for producing and studying the fatigue failure. In this machine a belt driven shaft carries a variable throw eccentric with a ball bearing strap, while a cantilever beam made of the material under investigation is held by spring pressure against the outer race of the ball bearing and thus receives the motion of the eccentric. By suitable adjustment of this motion a changing stress of definite distribution may be imposed on the beam through any number of cycles as registered on a revolution counter attached to the driving shaft. After a period of operation ranging from a hundred thousand to several million cycles, depending on the magnitude of the imposed stress, a typical fatigue crack develops at the most highly stressed location in the beam, and progresses slowly through the material.

By focusing a metallurgical microscope on the previously polished surface of the specimen the action of the high local stresses in the vicinity of the crack, and the plastic yielding and final fracture of the individual grains of the metal, may be observed. A further means of investigation is the use of a "Newton's rings" interferometer, introduced by the Institute staff, by which the surface deformations may be accurately measured and utilized in the analysis of the stress distribution in the affected region.

Through the use of this apparatus it has been possible to demonstrate that the mechanism of fatigue failure is much like that encountered in breaking off a piece of ductile wire by repeated sharp bending. The repeated plastic flow, first in one direction and then in the reverse direction, which is forced into the wire is also present in a minute area at the root of the fatigue crack, and is caused by the stress concentration accompanying all sharp notches. As is perfectly evident in the breaking of the wire, the material which withstands a few reversals of flow without harm will eventually harden and crack under this action, and thus cause the progression of the crack.

In the field of natural products is the work of Dr. W. F. Ross, a new-comer to the Institute. He was formerly at the Rockefeller Institute in New York City, working with Dr. M. Bergmann on the relation of synthetic peptides to the proteolytic enzymes.

The proteolytic enzymes are natural catalysts for breaking up proteins, the nitrogen containing constituents of the diet, into their components, the amino acids. By the proper choice of amino acids in synthetic polypeptides, it has been possible to correlate enzyme activity with specific properties of the peptide linkage involved: it was with this work that Dr. Ross was associated at the Rockefeller Institute. Amino acids, which contain in the same molecule both basic and acidic groups, may be coupled to form peptides by the intermolecular loss of water from these groups. A peptide linkage is thus formed. Such bonds hold together the amino acids in proteins, and are hydrolyzed by the proteolytic enzymes.

During digestion proteins are attacked first by pepsin within the stomach and are then completely hydrolyzed to amino acids by the pancreatic enzymes in the intestine. The pancreatic enzymes have been differentiated as follows: dipeptidase, which splits only dipeptides; carboxypeptidase, which attacks the peptide linkage at the carboxyl and of the chain; aminopeptidase, which splits at the amino end; and trypsin. Pepsin and trypsin were named proteinases because their action appeared to be restricted to the high molecular proteins. With the discovery by Bergmann and Ross that a simple peptide of lysine, a di-amino, mono-carboxylic acid, is split by trypsin, it became clear that the proteinases split normal

peptide linkages in low molecular peptides and are therefore true peptidases. Appropriate side chains of the amino acids forming the peptide linkage, as the free amino group in their synthetic substrate, a-benzoyl-glycyl-lysine amide, make the linkage available for proteinase action.

The relation of the highly colored porphyrins to proteins is being studied by Dr. Ross. In hemoglobin, protoporphyrin is associated through an atom of iron to globin, a protein of molecular weight 67,000. Hemoglobin through this linkage is enabled to combine reversibly with oxygen. The nature of the point within the protein at which combination occurs is not known; it is this which is the subject of especial attention. There is also being investigated the possibility that chlorophyll, a modified porphyrin-magnesium compound, may also be associated with a protein in nature to form a substance similar in composition to hemoglobin.

A photographic method of charting the night winds high above the earth, to determine direction and velocity for weather forecasting and aircraft operations, has been worked out in the meteorological laboratory of Technology.

Devised by Athelstan F. Spilhaus, of the Woods Hole Oceanographic Institute, who is now carrying on research at Technology, the photographic method of nocturnal wind soundings was announced at the meeting of the American Meteorological Society.

The method makes use of a "whole sky camera," which has a 180-degree lens; a pilot balloon and magnesium flares attached at intervals to a length of ordinary blasting fuse. From an observation point on the earth the camera lens is pointed upward, and, as the sounding balloon ascends, the flashes of the magnesium flares, ignited at known intervals are recorded on the plate. The photograph taken by the 180-degree camera is circular, the circumference depicting the horizon all around, and the brilliant magnesium flashes are registered on the plate regardless of the direction in which the balloon moves. Thus, by measuring the angles of elevation and direction between the camera station and the flashes, and correlating this data with the rate of ascent of the pilot balloon, an accurate record of the wind velocity and direction is obtained.

Test plates for recording the magnesium flashes at distances of as much as seven miles and at heights of over 13,000 feet have been made. It is expected that this distance and height can be greatly exceeded.

Michigan College of Mining and Technology.—Attendance records set at Michigan Tech six years ago were broken this fall when 262 new students and a total of 673 students were enrolled before the opening of classes on September 28. On the basis of average

January and March matriculation during the past decade, it is expected that more than 700 students will register in the course of the current college year.

The college has been saddened recently by the death of two men long influential in its growth: Emeritus Professor Arthur Edmund Seaman, a member of the teaching staff since 1890 and of the faculty since 1895. He had entered Michigan Tech, then the Michigan Mining School, as a member of the third class to matriculate; Dr. William Kelly, from 1897 to 1929 a member of the Tech board of control and its chairman from 1904 onward.

Faculty promotions include the advancement of N. H. Manderfield from acting head and associate professor of the department of metallurgy and ore dressing to head and professor, and the granting of assistant professorships to four men: John M. Gaffney and William A. Longacre in mathematics and physics, William Gertz in the protective coatings division of the metallurgy department, and Ernest J. Townsend in mining and engineering.

Men appointed to faculty positions during the summer include one assistant professor—Captain Keith R. Barney in the department of military science and tactics—and eight instructors: H. K. Burr, chemistry; W. O. Ray and Dr. M. J. Larsen, electrical; Dr. C. A. Newcomer, English; Alex Belda and G. R. Elwell, mechanical; Warren Cornell, metallurgy; and V. O. York, mathematics and physics.

Missouri School of Mines.—Professor William Reuel Chedsey was elected Director of the Missouri School of Mines, replacing Dr. Charles H. Fulton who resigned. Professor Chedsey was born in Boulder, Colorado, February 11, 1887. He graduated from the Manual Training School in Denver, Colorado School of Mines, where he received his degree as Engineer of Mines in 1908. During the years 1908–1910, Chedsey took graduate courses in electrical and mechanical engineering at the University of Idaho. Professor Chedsey was instructor of surveying at the Colorado School of Mines during his junior and senior years, and was associate professor of Mining Engineering at the University of Idaho during the years 1908–1911. Chedsey was Engineer in charge of the Central American Development Syndicate Ltd. in 1911–1912 and was connected with the Alaska Expedition Company Ltd., in 1912 and 1913. These companies were affiliated and assisted in the development of mines in Central America and Alaska by controlling their interests until the mines were large enough to be governed by a corporation. During the years 1913 to 1916, Chedsey was Associate Professor of Mining Engineering at the Colorado School of Mines.

Purdue University.—Forty-two new teachers and investigators have been added to the Purdue University engineering staff distributed as follows: 3 professors, 3 associate professors, 2 assistant professors, 13 instructors, 6 teaching assistants, 12 research assistants, 1 assistant in Extension and 2 assistants in Personnel.

The new professorial staff members include: C. W. Beese (B.S. M.E. 1915—M.E. Iowa State College 1923) Professor of Management and Head of the Department of General Engineering; K. D. Wood (M.E. Cornell 1922—M.S. 1926) Professor of Aeronautics; E. S. Ault (B.E. Johns Hopkins 1920—M.E. Cornell 1921—M.M.E. 1924) Professor of Machine Design; D. E. Ackerman (B.S. Pittsburgh 1924—M.S. 1924) Associate Professor of Chemical Engineering; P. C. Rutledge (S.B. Harvard 1927—S.M. M. I. T. 1933) Associate Professor of Civil Engineering; W. J. Cope (B.S. Utah 1923—M.E. Stanford 1929—D.Sc. M.I.T. 1937) Associate Professor of Mechanical Engineering; D. L. Arm (B.S. 1930—M.S. 1935 Lafayette College) Assistant Professor of Mechanical Engineering; J. Liston (B.S. Purdue 1930—M.E. 1935) Assistant Professor of Aeronautics.

The instructors are: E. O. Stitz (B.S.Ch.E. Purdue 1932—B.S. M.E. 1933) in Applied Mechanics; R. K. Toner (B.S. Rose 1934—M.S. Purdue 1936) in Chemical Engineering; Jack Newsom (B.S. Rose 1934) in Civil Engineering; T. J. Higgins (B.S. Cornell 1932—M.A. 1937) in Electrical Engineering; W. L. Hull (B.S. Colorado 1934—M.M.E. Chrysler Institute 1937) in Mechanical Engineering; E. W. Azpell (B.S. Wisconsin 1929—M.S. 1930) in Practical Mechanics; W. E. Fontaine (A.B. Central Y.M.C.A. Chicago) in Practical Mechanics; L. O. Johnston (B.S. Minnesota 1934—M.S. 1937) in Practical Mechanics; C. T. Marek (B.S. St. Thomas 1933) in Practical Mechanics; M. B. Scott (B.S.C.E. Nebraska 1934) in Practical Mechanics; L. W. Thomas (P.U. 1923) in Practical Mechanics; A. Jorgensen (B.S. and E. M. Michigan College of Mines and Technology 1924—M.S. in C.E. and Mechanics Illinois 1928) exchange instructor in Practical Mechanics; 1 new instructor in E.E.

The teaching assistants are: C. E. Stoops (B.S. O.S.U. 1937) in Chemical Engineering; M. R. Clapp (B.S. Texas Technological College 1935) in Mechanical Engineering; E. K. Gatcomb (B.S. University of Maine 1931) in Mechanical Engineering; A. W. Orr (B.S. University of Michigan 1936) in Mechanical Engineering; S. J. Sietsma (B.S. Purdue 1935) in Mechanical Engineering; W. A. Tooher (B.S. Washington University 1936) in Mechanical Engineering.

The new members in the Engineering Experiment Station are: J. C. Baker (B.S. E.E. Purdue 1934) Assistant; D. J. Belcher (B.

S.C.E. Purdue 1934) Office Engineer; W. R. Elliott (B.S. Saskatchewan 1932—M.S. Minnesota 1927) Hoffman Fellow; C. G. Hylkema (Iowa State College 1936) Assistant; R. F. Jackson (B.S. Purdue 1933) Research Engineer; R. I. Mayo (B.S. Maine 1937) Assistant; F. Milner (B.S. Purdue 1937) Assistant; H. A. Thomas (B.S. 1923—M.S. 1930 Illinois); O. R. Tyler (B.S. Indiana 1933) Research Chemist; W. F. Winn (B.S.C.E. North Dakota State College 1937) Assistant; M. K. Fahnestock (B.S. 1923—M.S. 1930 Illinois) Associate; T. E. Shelburne (B.S. Purdue 1927) Assistant. C. E. Dammon (A.B. Albion 1929—M.E. Michigan 1931), Assistant Director of Personnel, and J. N. Davis (B.S. Purdue 1936) Assistant to the Director of Personnel. G. Perkins (B.S.Ch.E. Purdue 1937) Assistant in the Engineering Extension Department.

Rensselaer Polytechnic Institute.—Promotions affecting nine faculty members and twenty-two additions to the teaching staff have been made at Rensselaer Polytechnic Institute. The promotions follow: From associate professors to professors, George H. Carragan, department of electrical engineering and physics; Stanley B. Wiltse, department of electrical engineering and physics; Guy M. Phelps, in charge of drawing courses. From assistant professor to associate professor, Harold B. Howe, drawing courses. From instructors to assistant professors, Turpin C. Bannister, department of architecture; William H. Rauscher, chemical engineering and chemistry; Lynn L. Merrill, Dennis B. Ames, Ralph E. Huston, mathematics.

The following have been named instructors: Chemistry and chemical engineering, G. E. Charles Wear, Raymond H. Hartigan, Howard G. Tennent, Stuart Sturges, Henry C. Ott; civil engineering, Norman L. Martinson, and Walter Lowery, Jr.; drawing, George B. Achtmeyer, Merrill H. Adams; economics and business administration, Everett R. Shaw, Clifford L. Hughes; electrical engineering and physics, Paul F. Bartunek, Robert A. Woodson; English, Robert C. Waddell, Fred Lape; mathematics, Dis Maly, Robert Stoll, Robert E. Street, Robert W. Rempfer; mechanical engineering, Charles C. Dillio, Joseph J. Ermenc, Milton R. Paulsen.

University of Southern California.—Robert E. Vivian, formerly director of research for the Metals Disintegrating Company of Elizabeth, New Jersey, has become Associate Professor of Chemical Engineering and head of department at the University of Southern California. Up to the present time chemical engineering has been a part of the Department of Chemistry, but is now a new department in the College of Engineering. Dr. Vivian received his

bachelor's degree in chemistry at the University of Southern California in 1917, and his doctor's degree from Columbia University in 1933 in chemical engineering. He has had long experience in chemical engineering work.

The enrollment in engineering this fall showed an increase of 20 per cent over that of last year.

Syracuse University.—Lloyd Logan of Baltimore, Md., has been appointed Professor of Chemical Engineering and head of that department, to succeed Dr. Albert Salathe, who resigned last spring. Dr. Logan is a graduate of Johns Hopkins University, Baltimore, Md., and has been a member of its engineering faculty for the past ten years, where he has been in charge of class, laboratory, plant and field work in Chemical Engineering unit processes, laboratory and plant instruction in gas engineering and senior thesis work in gas and chemical engineering subjects. At Johns Hopkins, he directed various research activities and was a member of the executive committee of the Board of Engineering Studies. He has held various technical positions with major chemical and manufacturing industries and has been retained as a consultant by industrial and utility concerns and groups. Dr. Logan is an active member of the American Institute of Chemical Engineers, American Chemical Society, American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, American Gas Association, Franklin Institute, American Association for the Advancement of Science, and Sigma XI, and has also been a member of various committees and subcommittees of the American Gas Association, including chemical and water gas committees. He has a number of publications to his credit and also holds several patents on chemical engineering equipment and processes which he invented.

Charles D. Luke, has been engaged as Assistant Professor of Chemical Engineering. Dr. Luke comes to the University from the De Florez Engineering Co. of New York, where he has had wide experience in the cracking art of the petroleum industry, which has involved plant test work, design and operation of cracking units, refinery surveys, cost analyses, and consultation with refineries on cracking research and development. Considerable time has been spent in pioneer research in the refinery and in the laboratory on the chemistry of cracking in connection with legal matters with which the firm was associated. Previously he was engaged with the Process Engineering Division of the Standard Oil Co. of Louisiana and was also engaged in consulting work in Chemical Engineering. Dr. Luke is a native of Iowa and received his Bachelor's degree from the University of Iowa. He attended the

Massachusetts Institute of Technology where he received the degree of Master of Science and Doctor of Science. While at the Institute he served as assistant to Dr. W. K. Lewis in the Petroleum Summer School of that institution and is co-author with Dr. Lewis on a thesis on "Vapor-Liquid Equilibria in Hydrocarbon Systems at High Pressure."

Cecil S. Camp, a member of the engineering faculty of the Mississippi State College, has been appointed Assistant Professor of Civil Engineering. Professor Camp secured his undergraduate degree in engineering from the University of Arkansas and his Master's degree in Mechanics and Hydraulics from the University of Iowa. He was formerly a member of the engineering faculty of the Oregon State Agricultural College and his engineering experience includes work with the Tennessee Valley Authority, United States Engineers (War Department), Arkansas State Highway Commission, Missouri State Highway Commission, Missouri Valley Bridge & Iron Co. Professor Camp is a member of the American Society of Civil Engineers, Society for the Promotion of Engineering Education, Sigma XI, Tau Beta Pi, Theta Tau and Lambda Chi Alpha. He will be in charge of Hydraulic laboratory instruction and will assist with other Civil Engineering work.

Russell T. Bull has been appointed Assistant in the Machine Shop. Mr. Bull comes to the University from the L. S. Smith Typewriter Co. where his work has been chiefly in connection with tool making. He served four years in railroad shop work and has had experience in various lines of machine work in this country and in Canada. His work in Syracuse and vicinity has been in connection with the manufacture of typewriters special machines for printing theatre tickets, die castings, tool room lathes, windshield wipers, talking machines, caps for milk bottles, etc. Mr. Bull's work at the University will be chiefly in connection with instruction in Machine Shop Practice. He will also aid in the development and maintenance of engineering laboratory and shop apparatus.

Yale University.—Hardy Cross whose election to the Chairmanship of the Department of Civil Engineering was announced in the January issue of the JOURNAL, was awarded the honorary degree of Doctor of Engineering at the 59th Annual Founders' Day exercises of Lehigh University in September. Walter J. Wohlenberg, Sterling Professor of Mechanical Engineering, was awarded the same degree at the 66th Commencement of the University of Nebraska last June.

Joseph W. Roe, professor emeritus in New York University and formerly a member of the Yale faculty, has been appointed Visiting Professor of Industrial Management for the current year, while

Professor Herbert L. Seward, now on sabbatical leave, is acting as Special Advisor on Shipping to Secretary of Commerce Roper.

Barnett F. Dodge, Chairman of the Department of Chemical Engineering, was recently appointed one of the representatives of the American Institute of Chemical Engineers on the Engineers' Council for Professional Development. Professor Dodge was also recently elected Vice-chairman of the Industrial Division of the American Chemical Society. Champion H. Mathewson, Chairman of the Department of Metallurgy and Metallography, was re-named Associate Editor of "Technologic Monographs" of the same Society at its meeting in September.

Milton L. Wiedmann has been promoted from an instructorship to an assistant professorship in Mechanical Engineering. Prior to coming to Yale in 1930, Mr. Wiedmann was an instructor in Leland Stanford University, where he received the A.B. degree in 1925 and the E.E. degree in 1926.

A. G. Conrad, Assistant Professor of Electrical Engineering, served during the past year as a member of the Committee of the Massachusetts Institute of Technology on Comprehensive Examinations in Electrical Engineering.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers announces the election on September 28th, 1937, of the following new officers for 1938 who will assume office on December 10, 1937:

President—H. N. Davis, President, Stevens Inst. of Technology, Hoboken, N. J.

Vice-Presidents—F. O. Hoagland, Master Mechanic, Pratt & Whitney Division, Niles Bement-Pond Co., Hartford, Conn.; B. M. Brigman, Dean, Speed Scientific School, University of Louisville, Louisville, Ky.; Harte Cooke, Mechanical Engineer, McIntosh & Seymour Corp., Auburn, N. Y.; W. H. McBryde, Construction Engineer, San Francisco, Calif.; L. W. Wallace, Director, Division of Engineering Research, Association of American Railroads, Chicago, Ill.

Managers—Carl L. Bausch, Vice-President, Bausch & Lomb Optical Co., Rochester, N. Y.; S. B. Earle, Dean, School of Engineering, Clemson A. & M. College, Clemson College, S. C.; F. H. Prouty, Partner, Prouty Brothers Engrg. Co., Denver, Colo.

BOOK REVIEWS

Fundamentals of Vacuum Tubes. AUSTIN V. EASTMAN, McGraw-Hill Book Co., 438 pages, $4.00.

The author states his intent in the writing of the book as: "to confine in a single text the basic theory underlying the operation of all types of Vacuum Tubes, both radio and industrial, together with their more common applications."

The book contains 12 chapters. Author's and subject indexes, together with two appendices, are included. Illustrations and diagrams are found throughout the book, the illustrations giving representative practices of a number of companies. Problems are included at the end of the chapters.

The material covered is by no means limited to theory and application of Vacuum Tubes, but covers Thyratrons, Rectifier, and Photosensitive, and other special tubes.

The author has produced a book which will undoubtedly fill the need of many schools for a text covering the work in the electronics field given to undergraduate engineers.

R. W. AHLQUIST.

Fundamentals of Engineering Electronics. WILLIAM DOW, John Wiley & Sons, 604 pages, Price, $5.00.

A review of this excellent book bears out the author's statement that a large part of the book is devoted "to the study of the various geometries and materials in electronic devices and a relatively small part to circuit studies." The book has been divided into two parts: I, Electrons, and II, Electrons, Atoms, and Radiation.

The chapters of Part I include such subjects as Potential Distribution diagrams, Electron Ballistics, Space Charge Flow, Thermionic Cathodes, and Distribution of Random Velocities of Gas Particles. The last three chapters of part I present applications of Vacuum Thermionic Tubes.

Part II is devoted to material covering Atomic Energies, Energy Levels, Photo-electric Emission, Plasma Boundary Regions, and the like. The last two chapters of this contain considerable application material for Thyratons, Ignitrons, and Rectifiers.

Problems are included at the end of each chapter, and many tables, references, and diagrams are found throughout the book. The author has designated all equations so that the reader knows whether the electric units are given in the electro-static, magnetic, or practical system.

The book is intended both for graduates' and for under-graduates' study as well as for a reference book. This book will probably set a standard in the field that it covers.

R. W. AHLQUIST.

Electrical Engineers' Handbook: Electric Communication and Electronics. HAROLD PENDER AND KNOX MCILWAIN. Third Edition rewritten. John Wiley & Sons, Inc., 1022 pages. $5\frac{5}{8} \times 8\frac{5}{8}$. Price $5.00.

No longer is "Pender" in one volume but in two volumes, known as "Electric Power" and "Electric Communication and Electronics." The latter is No. V in the "Wiley Engineering Handbook Series."

This volume covers the entire field of communication in 17 sections written by 54 nationally known contributors. The book covers telegraphy, telephony, radio broadcasting, public address systems, sound motion pictures, aviation and marine radio, medical applications of electricity, as well as complete mathematical tables and design data on circuit parts such as resistors, capacitors, inductors, transformers, microphones, loud speakers, wave filters, amplifiers, modulators, detectors, oscillators, antennae, power packs, and other.

It is the opinion of the reviewer that the data in the tables on metal tubes, thyratrons, photo-sensitive, cathode ray, X-ray, and other electronic tubes is the most complete and usable compilation to date.

The reviewer has used this volume as a reference textbook in his Electronic course for Senior Electrical Engineering students and found that it was very well adapted for instruction purposes.

This volume contains a wealth of information logically arranged and should find a field in class room instruction and also with any one engaged in Communication or Electronic work in industry.

P. E. RUSH.

Manual of Mathematics and Mechanics. G. R. CLEMENTS AND L. T. WILSON. McGraw-Hill Book Co., New York, 266 pages.

This manual contains facts and formulas which are useful to the students in courses in mathematics and mechanics in colleges and engineering schools. It is well written and well constructed physically. The twenty-four numerical tables are unusually easy to read on account of the comparatively large type used in them. The remarks and brief explanations concerning these tables should serve a useful purpose to the student in using the manual. The notes on computation are clearly written, concise and pointed. In

addition to a table of fundamental integrals, the manual contains a table of 332 well selected integrals and a set of thirty selected definite integrals. The section on infinite series begins with pertinent remarks on convergence and divergence. The seventy-seven pages devoted to rules and formulas from plane and solid geometry, algebra, trigonometry, spherical trigonometry, hyperbolic functions, plane and solid analytic geometry, and the differential and integral calculus seem adequate. Sketches of special quadric surfaces and of many curves for reference are included. The section on differential equations gives methods of solving several types. Three pages are given to vectors and operations with them. Forty-two pages are given to discussion and tables of topics selected from mechanics, including a table of some properties of eighteen selected types of plane areas and a table of some properties of nineteen selected types of bodies of constant density. In the opinion of the reviewer this is a very good manual.

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